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(54) Title: COMPUTER BASED EVENT CAPTURING SYSTEM AND METHOD HAVING FLEXIBLE STORAGE (57) Abstract A computer based event capturing system and method allows the flexibility of capturing variable but unrelated lengths of video image sequences before an event, during an event and after an event. The event capturing system and method stores video images recorded during monitoring in a fixed number of files such that once the maximum number of files to be stored during monitoring has been reached, the oldest file is deleted and the newly captured video image file is stored in a new location in storage. Thus, storage of the files during monitoring has the appearance of a circular format. Video images recorded after the occurrence of one or more events are stored in files in a linear format. The number of files stored in permanent storage from those recorded during monitoring is unrelated to the number of files stored after the event. In addition to being unrelated to the number of pre-event files permanently stored, the number of post-event files permanently stored is also unrelated to the total number of files corresponding to the video images captured before, during and after the event. The event capturing system and method also enables local and remote storage and playback capability of video images from multiple locations in an environment.		

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**COMPUTER BASED EVENT CAPTURING SYSTEM
AND METHOD HAVING FLEXIBLE STORAGE**

Field of the Invention

This invention relates to systems and methods used in monitoring and control in manufacturing and other environments, and more specifically to computer
5 based event capturing systems which permit "hands free" monitoring and control.

Background of the Invention

Event capturing systems and methods are widely used for capturing video images of random
10 "events" in a manufacturing or other environment. Examples of events include excessive pressure, insufficient pressure, incorrect positioning of parts, etc. These systems typically operate in a monitoring mode during which video images of the environment are
15 recorded until such time as an event occurs within the environment. Upon the occurrence of an event, the video image of the event is also recorded, i.e., captured. After the event is captured, the video image captured during monitoring and the occurrence of the
20 event may be replayed so that an engineer or other maintenance personnel can analyze the event.

Event capturing systems and methods may be classified into two major categories. The first category is analog video recording systems and the
25 second category is high speed, solid state, fast frame recorders. The analog video recording systems record video onto magnetic tape in either slow or high speed formats. These systems typically require the recording of a large number of video images to insure that pre-
30 event images (i.e., images of the environment prior to the occurrence of the event) are captured. Once an event occurs, the magnetic tape is linearly searched,

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which is often done manually, for the occurrence of the event on the magnetic tape. The tape is played in reverse to obtain the desired number of pre-event video images, and played in forward mode to obtain the
5 desired number of post-event video images. The tape is edited in order to review only the desired portion of the video tape. Individual frames of the video images are converted to digital images or negatives in order to print hard copies of the individual frames. High
10 speed analog video recording systems generally are expensive, and are capable of recording for only brief periods of time (i.e., a few seconds).

The second category of video event capturing systems is high speed, solid state, fast frame
15 recorders. These systems record video at high speed and store the video images in a digitized format directly in solid state memory. As a result, the video images can be replayed at slower speeds. The images are recorded in memory in a first-in first-out ("FIFO")
20 format resulting in continuous recording of the video images in a circular fashion, with the oldest images being overwritten by the newest images. Images are continuously recorded in a circular memory during monitoring until the desired event occurs. Once the
25 desired event occurs, the system records the post-event video images in a circular fashion based on a predetermined delay. As a result, the number of pre-event video images is a function of the number of post-event video images. Therefore, the number of pre-event
30 video images is directly related to the total amount of memory available, i.e., the size of the circular memory.

One example of a computer based event capturing system is disclosed in U.S. Patent No.
35 5,150,436 to Blessinger. The solid state, fast frame recorder disclosed by Blessinger records images of an event at a fast frame rate and plays back the images at

a slower frame rate to facilitate analysis of the event. The fast frame recorder has a solid state memory capable of continuously recording an event in a circular format until an external trigger terminates recording. The number of images recorded before and after the triggering event may be varied. However, the number of frames recorded before and the number of frames recorded after the triggering event are related in that the total number of frames is fixed and cannot be any greater than the total number of frames capable of being recorded in the circular memory at any one time.

The external trigger in the Blessinger system stops storage of image frames in solid state memory upon detection of a physical phenomena unique to the event being recorded. By delaying the signal to stop recording, image frames before and after the triggering event may be stored. As a result of being able to vary the delay in recording, Blessinger allows the capture of a random occurring event. However, the Blessinger system can capture only a single event.

Another example of an event capturing system is disclosed in U.S. Patent No. 5,034,811 to Palm. This solid state motion analysis system stores digitized image frames in solid state memory. This system compares selected image frames produced by a solid state imager to identify the occurrence of a change in a characteristic between particular image frames. A first frame is set as a standard. If a change in the image characteristic is determined between subsequent frames and the standard frame, a trigger signal is produced to alter the mode of operation of the motion analysis system in order to capture a desired event. As a result, the trigger signal causes the solid state memory to either begin or stop recording image frames produced by the solid state imager.

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Unfortunately, the prior art systems may not provide the flexibility necessary in order to capture images of real world events. Real world events may require capturing a large number of pre-event images and a small number of post-event images. Alternatively, real world events may require capturing a small number of pre-event images and a large number of post-event images. In addition, it is not uncommon for multiple events to occur at a single location in the environment or different locations in the environment. Prior art systems may not capture multiple events occurring at a single location in the environment or at different locations in the environment, using a single event capturing system. Thus, multiple events from either a single video or audio device or multiple video or audio devices may need to be captured. Therefore, flexibility with respect to the number of pre-event and post-event images, and the number of events captured is needed.

Summary of the Invention

It is, therefore, an object of the present invention to provide a flexible computer based event capturing system and method.

It is another object of the present invention to provide a computer based event capturing system and method for capturing real world events which may require varying amounts of pre-event, event and post-event images.

It is still a further object of the present invention to provide a computer based event capturing system and method for capturing multiple events at a single location and multiple events at different locations in the environment.

These and other objects are provided according to the present invention by a computer based event capturing system and method which captures images

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of an operational environment during monitoring, continuously records the images captured during monitoring in storage in a circular format until a maximum number of images have been stored. Thereafter, the oldest images are deleted from storage and the newest images are stored so that no greater than the maximum number of images is stored at any given time. The event capturing system includes event triggers which are responsive to the occurrence of an event in the environment and which signal the occurrence of the event. Upon the occurrence of an event signaled by an event trigger, a second predetermined number of images of the environment are captured and stored in noncircular storage. The second predetermined number of images which are captured and stored in noncircular storage is unrelated to the first predetermined number of images which are captured and stored in circular storage.

In addition, the event capturing system may also have additional event triggers which signal the occurrence of events at different locations in the environment. If the additional event triggers signal the occurrence of an additional event at a second location in the environment, another predetermined number of images of the environment after the occurrence of the second event are captured and stored in noncircular storage. Similarly, this predetermined number of images of the environment captured after the second event and stored in noncircular storage is unrelated to the predetermined number of images captured before the second event and stored in circular storage.

In an alternative embodiment, the event capturing system and method captures images from an environment during monitoring, continuously records the images of the environment in circular storage having a first predetermined length, with the oldest image being

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deleted and the newest image being stored in a new location once the number of images stored is equal to the first predetermined length. The event capturing system according to the alternative embodiment also includes event triggers which signal the occurrence of an event in the environment. Upon the signaling of the occurrence of an event in the environment by one of the event triggers, a converter converts the circular storage to noncircular storage having a second predetermined length to enable the continuous recording of captured images. As a result, the predetermined length of the storage after it is converted by the converter is unrelated to the predetermined length of the storage prior to the conversion by the converter.

The event capturing system and method may capture video, audio, video and audio, as well as other types of images. In addition, essentially any type of event trigger may be used. Furthermore, the event capturing system may be connected to a local or wide area network to permit both local and remote storage and playback of the captured images.

As a result, the computer based event capturing system can be tailored to real world events without worrying about hardware limitations, storage limitations, or other limitations which may affect prior art systems.

Brief Description of the Drawings

A preferred form of the invention is illustrated in the accompanying drawings, in which:

FIG. 1 is a high level block diagram of a computer based event capturing system according to the invention;

FIG. 2 is a diagram of the physical structure of the computer based event capturing system referred to in FIG. 1;

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FIG. 3 is a high level flowchart illustrating the operational control of the computer based event capturing system referred to in FIGS. 1 and 2;

FIGS. 4A through 4E are block diagrams of the setup, monitoring, capturing, archiving and playback subsystems of the present invention;

FIGS. 5A through 5C illustrate storage segmentation and usage by the monitoring and capturing subsystems of the present invention;

FIGS. 6A through 6B illustrate storage segmentation and usage by the monitoring and capturing subsystems of the present invention; and

FIGS. 7A through 7F are flowcharts illustrating the operational control of the monitoring, capturing and playback subsystems.

Description of the Preferred Embodiment

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which a preferred embodiment of the invention is shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiment set forth herein; rather, this embodiment is provided so that this disclosure will be thorough and complete, and will convey the scope of the invention fully to those skilled in the art. Like numbers refer to like elements throughout.

General Overview: Computer Based Event Capturing System and Method

The computer based event capturing system and method according to the present invention enables events to be captured using a "hands-free" system. The system and method provides the advantages of greatly increased flexibility, ease of use and accessibility to video playback with respect to the number of signals that can be captured, the variable but unrelated

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lengths of the video image sequences for pre-event video and post-event video, and the ease of both local and remote storage and playback capability. The present system and method also may be used in
5 combination with high speed cameras to provide high speed video, which results in high quality images. This is achieved by sampling frames of video images from the high speed cameras.

The computer based event capturing system and
10 method of the present invention also has increased flexibility in the number of different environments in which it can be used. For example, this system and method may be used for monitoring manufacturing environments for quality control or trouble shooting,
15 for security purposes, for remote periodic monitoring, for remote random event driven recording or for monitoring of aircraft systems or the like to be played back during disaster analysis.

Referring to Figure 1, a general overview of
20 a computer based event capturing system 10 will be described. The system 10 includes a computer system 12 having a processor 14 and event capturing system 16. The computer system 12 is connected to data storage 18. In addition, the computer system 12 is also connected
25 to several input/output peripheral devices including input 20 and display 22. Still further, additional input/output peripheral devices including image capture/video input 24 and event triggers 26 are also connected to computer system 12. Input 20 may consist
30 of a keyboard, a mouse, a virtual track ball, a light pen or any other number of devices, individually or collectively used for entering data or selecting options in computing environments. Display 22 may be a color cathode-ray tube, or any other type of display
35 device. In addition, a printing device 29 (see Figure 2) may also be connected to the computer system 12, the printing device taking the form of a laser printer, or

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any other type of printing device which may be used for printing graphic images or other information or documentation.

Preferably, processor 14 is a personal computer. Data storage 18 may include hard disk drives, tapes, etc., or any combination thereof. Data storage 18 may also be segmented into local working storage and local permanent storage. Processor 14 communicates with input 20, display 22, image capture/video input 24, event triggers 26 and data storage 18. The computer system also contains event capturing system 16. Event capturing system 16 communicates with processor 14. Event capturing system 16 is preferably implemented as a stored program which executes on processor 14. Alternatively, event capturing system 16 may be implemented in special purpose hardware or a combination of hardware and software.

The local permanent storage may include local hard disks, optical storage, floppy disks or other local permanent storage devices. Permanent storage may also include remote hard disks, optical storage or other permanent storage devices which are either remote to the stand alone computer based event capturing system 10 or which may be accessed via network 30 (see Figure 2).

Image capture/video input 24 may take the form of a standard VHS video camera 23 (see Figures 4A-4E) in combination with the necessary video capture card 21 (see Figures 4A-4E). Video multiplexer 25 (see Figure 2) is also included in image capture/video input 24 if multiple video cameras 23 are used. The video input signal takes the form of a NSTC (i.e., National Television Standards Committee) or PAL (i.e., Phase Alternation/Alternate/Alternating Line) signal. An example of the video cameras which may be used include Panasonic Model WV CL354, manufactured by Matsushita

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Communication Industrial Company, Ltd. of Yokohama, Japan. A video capture card which is suitable for use in combination with the video camera, as combined to form the image capture/video input 24, includes the DVA
5 4000 card marketed by Video Logic, Inc. of Cambridge, Massachusetts. Multiple VHS cameras may be used, with the multiple cameras being connected to a video multiplexer. The video cameras, which may be portable, can be either hardwired (i.e., directly connected) to
10 the video capture cards or may be connected by wireless means.

Event triggers 26 may be either discrete or analog devices. Examples of these devices include PLCs (i.e., programmable logic controls), measuring devices,
15 DCSs (distributive control systems), dry contacts or discrete pulse triggers. Each of these serial triggers is connected to a serial input multiplexer 27 (see Figure 2) which in turn is then connected to a communication serial port input/output card 102 (see
20 Figures 4A-4E) for receiving the serial trigger signal.

Finally, the computer based event capturing system 10 can operate in an isolated, stand alone environment or can be connected to a local or wide area network 30 (see Figure 2). It will be understood by
25 those having skill in the art that in order to connect the computer based event capturing system 10 to a local or wide area network, a network interface card 104 (see Figures 4A-4E) is required.

Overview: Event Capturing System Physical Structure

30 Referring to Figure 2, a detailed illustration of the physical structure of the computer based event capturing system 10 is illustrated. As illustrated, computer system 12 is connected to input devices 20, display 22 and printer 29. In addition,
35 computer system 12 is also connected to image capture/video input 24 and event triggers 26. Finally,

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computer system 12 may be connected to a network 30 which has a number of additional devices including additional event triggers 34, computer systems 36 and file server 32 connected thereto. Image capture/video input 24 includes at least one video camera 23, and may include the multiple VHS cameras or other video input devices 23a-23n. Each of the video cameras 23 is connected to a video multiplexer 25. As previously described, event triggers 26 may include a number of different serial triggers including PLC 26a, analog signal 26b, dry contact 26c and/or discrete pulse trigger 26d. Each of these event triggers 26 is connected to a serial input multiplexer 27, which in turn is connected to computer system 12 for purposes of communicating the event trigger signal generated by event triggers 26 to computer system 12.

Overview: Event Capturing System
and Method Components (Subsystems)

Referring to Figure 3, a high level flowchart of event capturing system 16 will now be described. Event capturing system 16 contains subsystems for system start up 50, setup 52, monitoring 54, capturing 56, archiving 58, and playback 60. The components of event capturing system 16 will now be described generally. A detailed description of many of these components will be described below in the sections labeled "Detailed Operation." Start-up subsystem 50 essentially allows the user to either begin or complete three different tasks (i.e., shut down, setup or event capture). If the user selects to evoke the setup subsystem, control is transferred to setup subsystem 52. If the user decides to shut down event capturing system 16, the system is exited and any files stored in permanent storage (see data storage 18 in Figure 1) are permanently maintained. During shut down, event capturing system 16 will close any open files, stop all programs running in the Windows™ environment and return

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control to computer system 12. Finally, if the user decides to start the event capturing process, control is transferred to monitoring subsystem 54.

Setup subsystem 52 is implemented by event capturing system 16 to define various parameters used by event capturing system 16. For example, during implementation of setup subsystem 52, various security measures may be changed including the password for the current user. In addition, the user may also add, remove or rename predefined capture definitions. The user also may select a printer, change the video logic program, or transfer control to a Microsoft Windows™ program, manager program or to a MicroSoft Windows™ file manager program. In addition, the user may enable or disable various event triggers including various mouse triggers, COM (i.e., communication port) triggers such as PLCs, analog signals, dry contacts or discrete pulse triggers, and DDE (i.e., dynamic data exchange) triggers. Finally, the user may change the recorder settings (i.e., the recording setup for the currently selected predefined capture definitions). By changing the recorder settings, the user may define the temporary work directory, the permanent record directory, the length of the video image sequence being recorded during the pre-event, event and post-event periods, the number of pre-event sequences or files permanently saved and the number of post-event sequences or files permanently saved. Additionally, the user can select to record sequences directly to permanent storage, to record sequences to working storage and archive them to permanent storage, or to record sequences to working storage, merge the files into a single file and archive the resulting single file in permanent storage.

Monitoring subsystem 54 of event capturing system 16 begins the actual event capturing process. The monitoring subsystem 54 records video image

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sequences (i.e., files) of a manufacturing or other environment. The length of the video image sequences or files is determined by the setup subsystem. The number of video image sequences or files which are
5 stored in local working storage at any given time during monitoring is set by the event capturing system 16. The video image sequences or files obtained by the image capture/video input 24 during monitoring are recorded in a circular fashion such that the oldest
10 video image sequence or file may be overwritten by the newest video image sequence or file. As an alternative, the storage location used for storing the oldest video image sequence or file may be released and the newly retrieved video image sequence or file may be
15 stored in the next available location in the local working storage.

During monitoring, a live video picture may be displayed on display 22. Still further, the user has the option of: (i) reviewing previously captured
20 image sequences or files retrieved by the playback subsystem by transferring control to playback subsystem 60, (ii) returning to setup subsystem 52 in order to further define various parameters to be utilized by the event capturing system 16, or (iii) exiting the
25 monitoring process and returning to the start up subsystem 50. The segmentation and usage of the local working storage used by the monitoring subsystem 54 will be described below with respect to Figures 5A-5C.

Once event capturing system 16 receives a
30 trigger signal from one of event triggers 26, control is transferred to capture subsystem 56. Capture subsystem 56 controls the recording of video image sequences or files during the event as well as after the event has occurred. Three options are available to
35 the user of event capturing system 16. The user can indicate that the video image sequences or files are to be stored directly in permanent storage so that files

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saved during monitoring (i.e., pre-event files), during the event and during capture (i.e., post-event files) are stored directly in permanent storage. The second option is to record the video image files in working storage, and then archive the video image files in permanent storage such that files recorded during monitoring (i.e., pre-event files) are stored in the local working storage, all files recorded during the event and after the event (i.e., post-event) are stored in local working storage, and thereafter, all files are archived to permanent storage. In this case, once all files have been archived in permanent storage, they are deleted from working storage. Finally, the third alternative is to record the video image files in working storage, merge or concatenate the pre-event video image files, the event image files and the post-event image files into one large file, and archive the one large file to permanent storage. The three sets of files are merged and copied to permanent storage. All files stored in working storage are deleted.

The number of video files recorded by capture subsystem 56 is limited only by the number of files or segments containing an event plus the setting of the parameter for the number of post-event segments to be saved. This parameter, as previously described, is defined by setup subsystem 52. The number of post-event files is not related to the number of pre-event files nor the total number of pre-event, event and post-event files. The segmentation and usage of the storage for storing the post-event files will be described below with respect to Figures 5A-5C.

Subsystem 58 provides for archiving of the video image sequences or files and storage of those files in permanent storage.

Finally, playback subsystem 60 allows the user to review the video image files from the pre-event, event and post-event periods for any particular

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event. By default, the latest event captured will be displayed on display 22. However, the user may select any event which has been captured and may review the pre-event, event and post-event files for any given
5 event.

Detailed Structure of Event Capturing System and Method

Referring to Figures 4A-4E, block diagrams illustrating the functionality of the setup 52, monitoring 54, capturing 56, archiving 58 and playback
10 60 subsystems will now be described. The functionality of setup subsystem 52 (see Figure 3) may be represented by the block diagram illustrated in Figure 4A. Those components of the computer based event capturing system
10 illustrated by the hashed marks (e.g., video camera 23 or event triggers 26) are not utilized by the setup
15 subsystem. During setup, event capturing system 16 causes processor 14 to display setup screens on display 22 via the SVGA video card 106. The event capturing system 16 also allows the processor 14 to control user
20 setting of various setup definitions which are then stored in local working storage 18a. The setup definitions are the predefined capture setup definitions used by the event capturing system 16 during operation.

25 Referring to Figure 4B, the functionality of monitoring subsystem 54 will now be described. During monitoring, the video image of the environment is captured by the combination of video camera 23 and video capture card 21. The captured images are then
30 transferred to the processor 14. Processor 14 buffers the images into files or sequences of the size defined by the predefined capture setup definitions and stores the files in local working storage 18a. The maximum number of files stored in local working storage 18a at
35 any given time is set by the event capturing system 16. Once the maximum number of files (i.e., n files) have

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been stored, the storage location for the oldest file in local working storage 18a is either overwritten by the newest file or, in the alternative, is released and the newly captured image file is stored in the next
5 available storage location in local working storage 18a. Concurrent with the storage of the image files in local working storage 18a, event capturing system 16 also causes processor 14 to transfer the video images to SVGA video card 106, and then in turn to video
10 playback card 108 which causes the images to be displayed on display 22 for viewing by the user. This process continues until an event trigger signal is either received from event triggers 26 or across network 30 and network interface card 104 or the user
15 chooses to exit the monitoring subsystem.

Referring to Figure 4C, functionality of capturing subsystem 56 will now be described. The functionality of capturing subsystem 56 is similar to that of monitoring subsystem 54 described with respect
20 to Figure 4B in that video images continue to be captured by image capture/video input 24 (i.e., video camera 23 and video capture card 21) and stored in local working storage 18a by processor 14. In addition, the captured video images continue to be
25 displayed on display 22. However, capturing subsystem 56 is activated once monitoring subsystem 54 receives an event trigger signal from event triggers 26 or across network 30. Upon receipt of the event trigger signal, event capturing system 16 causes processor 14
30 to change the method for storing the video image files in local working storage 18a. While the video image files were stored in local working storage 18a in a circular fashion during monitoring, event capturing system 16 causes processor 14 to change the control of
35 local working storage 18 so that the video image files are no longer stored in a circular fashion. Rather, the video image file(s) containing the event(s) is

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stored in local working storage 18a in the next available location. Thereafter, the video image files containing the images captured after the event (i.e., post-event files) are stored in local working storage 5 18a in a sequential manner without reference to the predefined maximum number of pre-event files. As a result, the number of post-event video image files (i.e., m files) is limited only by the predefined maximum number of post-event video image files which 10 was defined during setup, and not by the maximum number of pre-event video image files (i.e., n files). This storage scheme will be further described below with respect to Figures 5A-5C below. Video image files recorded during the post-event phase continue to be 15 captured and stored in local working storage 18a until the maximum number of post-event video image files as defined during setup has been captured.

Referring to Figure 4D, the functionality of archiving subsystem 58 will now be described. During 20 archiving, the video image files recorded during the pre-event, event and post-event periods for a particular event are transferred from local working storage 18a to either local permanent storage 18b or, in the alternative, to a network file server via 25 network interface card 104 and network 30. The user may indicate the location where the captured pre-event, event and post-event video image files are to be stored during execution of setup subsystem 52. Also during archiving, the video images of the environment continue 30 to be displayed by processor 14 on display 22. In addition, depending on the option selected by the user, the files in local working storage may be deleted or erased.

Referring to Figure 4E, the functionality of 35 playback subsystem 60 will now be described. If the pre-event, event and post-event video image files for the particular event which is to be reviewed or played

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back are stored in local permanent storage 18b, event capturing system 16 retrieves the pre-event, event and post-event video image file to be reviewed from local permanent storage 18b, and causes processor 14 to

5 transfer the video images to SVGA video card 106. These images are then transferred to video playback card 108, and displayed on display 22 for review by an engineer or another individual conducting an analysis of the event. If the pre-event, event and post-event

10 video image file for the particular event has been stored on a file server or at another location on network 30, event capturing system 16 retrieves the video image file from that remote location via network 30 using network interface card 104 and causes the

15 video image file for the particular event to be displayed on display 22.

Detailed Description: Storage Segmentation and Usage

Referring to Figures 5A-5C and Figures 6A-6B, the segmentation and usage of storage during monitoring and capturing will now be described. As previously

20 described above, the video image files are stored in a circular fashion during monitoring and are stored in a non-circular fashion during capturing after the occurrence of an event. As a result, there is no

25 correspondence between the number of video image files stored during the post-event period and the number of video image files stored during monitoring in the pre-event period.

Referring to Figures 5A-5C, a diagram

30 illustrating the storage of video image files during the pre-event, event and post-event periods is illustrated. Manipulation of local working storage during monitoring is illustrated in Figure 5A. Each video image file (which may be referred to as either a

35 video clip or segment) has a length of t seconds. This length is predefined by the user in the setup

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subsystem. Similarly, a maximum of n files are stored in local working storage 18a at any given time during monitoring. Once n files have been stored in local working storage, the storage location for the oldest file is released and the newest file (i.e., file $n+1$) is stored in the next available location in local working storage 18a. As an alternative, the location in local working storage 18a having the oldest file stored therein may simply be overwritten with the newest file (i.e., file $n+1$). Each video image file is given a unique date/time/event stamp file name. Thus, as illustrated in Figure 5A, once n files have been stored in local working storage 18a, the oldest file (i.e., 100000.EXT) is deleted and the newest file is stored in the next available location of local working storage (i.e., 100400.EXT).

Referring to Figure 5B, the management of local working storage during capturing of an event will now be described. When an event occurs, the images occurring right after the event continue to be recorded until the recording of the video image file containing the event is completed. Referring to Figure 5B, an event occurred at 150. Once the recording of the video image file containing the event is completed, the file containing the event is renamed to specifically identify it as the file which contains an event (e.g., 100400EV.EXT). Event capturing system 16 then continues to record images of the environment until the total number of post-event files as defined by the user during setup have been recorded. Referring to Figure 5B and assuming that the number of pre-event files and the number of post-event files were defined by the user during setup as two and five, respectively, event capturing system 16 records five video image files after the file containing the event. Upon completion of the recording of all post-event files (in this case, five post-event files), the pre-event files (e.g.,

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100300.EXT and 100330.EXT), the event file (e.g.,
100400EV.EXT) and the post-event files (e.g.,
100430.EXT, 100500.EXT, 100530.EXT, 100600.EXT and
100630.EXT) are all tagged and identified for storage
5 in permanent storage. Thereafter, event capturing
system 16 moves all the tagged flags to permanent
storage, deletes all video image files older than the
oldest pre-event file which was tagged and moved to
permanent storage, and starts recording the next video
10 image file for monitoring. As illustrated in Figure
5B, event capturing system deletes all files older than
the video image file having filename 100300.EXT and
begins monitoring the environment by recording the next
video images in the file named 100700.EXT.

15 Referring to Figure 5C, management of local
working storage during capturing of multiple events
will now be described. Local working storage 18a is
managed in essentially the same manner whether a single
event or multiple events occur. For example, assuming
20 that an event occurs at 160 as illustrated in Figure
5C, event capturing system 16 continues recording
images of the environment until the file containing
event 160 is completed and renames this file to
identify it as a file containing an event (e.g.,
25 100400EV.EXT). This file is then tagged for permanent
storage. Event capturing system 16 then begins to
record the post-event files for first event 160.
Assuming that the number of post-event files was
predefined by the user during setup as three, event
30 capturing system 16 records the next three video image
files. However, while recording the post-event files
for the first event 160, event capturing system
identifies a second event 162 and a third event 164
which are both recorded in the same video image file.
35 As a result, event capturing system 16 continues
recording images of the environment until the video
image file containing events 162 and 164 has been

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completed and then renames this file to identify it as a file containing one or more events (e.g., 100430EV.EXT). In addition to being a file that contains one or more events, this file is also a post-event file for the first event 160. Event capturing system 16 tags this file (i.e., 100430EV.EXT) for permanent storage and starts recording the post-event files for the second event 162 and third event 164. However, during recording of the post-event file for the second event 162 and third event 164, event capturing system 16 identifies a fourth event 166. As a result, event capturing system 16 continues recording images of the environment until the video image file containing the fourth event 166 is completed, renames this file to identify it as a file containing an event (e.g., 100500EV.EXT) and tags this file for permanent storage. Thereafter, event capturing system 16 then proceeds to capture the post-event files for the fourth event 166. Upon completion of the post-event files for 166 (e.g., 1005300.EXT, 100600.EXT and 100630.EXT), the two pre-event files (i.e., 100300.EXT and 100330.EXT) and the three post-event files (i.e., 100530.EXT, 100600.EXT and 100630.EXT) are tagged for permanent storage and all of the tagged pre-event, event and post-event files are moved to permanent storage.

Thereafter, event capturing system 16 deletes all files captured during the monitoring period which are older than the oldest pre-event file and begins monitoring the environment by recording the next video images in the file named 100700.EXT.

Referring to Figures 6A and 6B, the management of local working storage during monitoring and capturing may be represented in a different manner. For example, in Figure 6A, n files are recorded during monitoring. Once pre-event file $n+1$ is recorded, pre-event file 1 is deleted. This process continues with the oldest pre-event file being deleted upon the newest

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pre-event file being recorded so that n pre-event files are stored in local working storage at any given time during monitoring.

Referring to Figure 6B, the management of local working storage during capturing is illustrated. Upon the occurrence of one or more events, event capturing system 16 records the number of post-event video image files as defined by the user during setup. Thereafter, the number of pre-event video image files as defined by the user during setup, the video image files containing each of the one or more events and the number of post-event video image files as defined by the user during setup are each tagged for permanent storage. All tagged files are then moved to permanent storage. The pre-event video image files older than the oldest pre-event video image file are then deleted from local working storage.

The minimum number of pre-event video image files which can be permanently saved is 0 and the maximum number of pre-event video image files which can be permanently saved is n . The minimum number of event video image files which can be permanently saved is 1 while the maximum number of event video image files which can be permanently saved is limited only by the maximum logical size of the currently selected permanent storage. Finally, the minimum number of post-event video image files which may be permanently stored is 0 and the maximum number of post-event video image files which may be permanently stored is limited by the number defined by the user during setup and the maximum logical size of the currently selected permanent storage (i.e., m files). As a result, there is no relationship between the maximum number of post-event video image files (i.e., m files) and the maximum number of pre-event video image files (i.e., n files). Similarly, there is no correspondence between the maximum number of post-event video image files and the

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total number of video image files stored in permanent storage for a particularly event. In addition, the length of each video image file (i.e., length of the segment in seconds) may vary.

5 For example, the number of pre-event files may be 5 while the number of post-event files may be 1. Alternatively, the number of pre-event files may be 4 while the number of post-event files may be 6. Still further, the length of each file or segment may be, for
10 example, 15, 30 or 45 seconds.

Detailed Operation: Event Capturing System Software

The sequence of operations performed by the event capturing system will now be described with reference to Figures 7A-7F. The flowcharts in Figures
15 7A-7F provide the flow control for the monitoring subsystem, the capturing subsystem and the playback subsystem. It will be understood by those having skill in the art that the operational flow defined by the flowcharts in Figures 7A-7F may be implemented by
20 computer system 12, operating under stored program control.

Detailed Operation: Monitoring Subsystem

Referring to Figures 7A-7C, the detailed operation of the monitoring subsystem will be
25 described. At the outset, event capturing system 12 loads the setup parameters defined during setup at 202. The parameters loaded are those for the current or the most recently selected capture setup definitions. If the event capturing system is continuing to monitor
30 using the current set of capture setup definitions, then the most recent selected captured setup definitions are loaded. Thereafter, a determination is made at 203 as to whether this is the first time that the monitoring subsystem and capturing subsystem have
35 executed using the selected capture setup definitions

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set. If it is determined at 203 that this is the first time that the monitoring subsystem and capturing subsystem have executed on the selected setup definition set, a subdirectory identified using the
5 current date as the name for the permanent video image file directory is created at 204.

Whether or not this is the first time that the selected setup definitions set has been used by the monitoring subsystem and capturing subsystem, a
10 determination is made at 206 as to whether the user has indicated that the event capturing system is to be started. If the user has selected to exit the event capturing system, control is returned so that the system may be restarted in the future. If the user has
15 not selected to exit the event capturing system, a determination is made at 208 as to whether an event trigger has occurred. If an event trigger has occurred, control is transferred to the capturing subsystem which is described below with respect to
20 Figure 7D. If no event trigger has occurred, a determination is made at 210 as to whether a video image file was currently being recorded.

If it is determined at 210 that a video image file is currently being recorded, a determination is
25 made at 212 as to whether the current video image file has been completely recorded (i.e., whether t seconds of video image as defined during setup have been saved). If it is determined that t seconds of video have been saved, the current video image file is closed
30 at 214. Thereafter, a determination is made at 216 as to whether the number of video image files stored during monitoring in the local working storage is greater than n files as defined during setup. If it is determined that the maximum number of video image files
35 to be stored during monitoring has not been exceeded, a new file is opened, the new file is named with the time of creation, the new file is tagged as a "monitor"

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file, and event capturing system begins recording images and storing the images in the new file at 218. If it is determined at 216 that the number of monitoring video image files presently stored in the local working storage is greater than n files, then the oldest monitoring video image file is deleted from the local working storage at 220. Thereafter, a new video image file is opened, the new file is named with the time of creation, the new file is tagged as a "monitor" file and the event capturing system begins recording images in the new video image file at 222.

If it is determined at 210 that a video image file was not presently being recorded, a determination is made at 230 as to whether the number of monitor video image files in the local working storage is greater than n files (i.e., the maximum number of monitoring files as defined during setup). If it is determined that the number of monitoring video image files is less than the maximum allowed, a new video image file is opened, the new file is named with the time of creation, the new file is tagged as a "monitor" file and the event capturing system begins recording video images and storing them in the new video image file at 232. However, if it is determined that the number of monitor video image files presently stored in the local working storage is greater than the maximum number allowed, then the oldest monitor video image file is deleted from the local working storage at 234. Thereafter, a new video image file is opened, the file is named with the time of creation, the file is tagged as a "monitor" file, and images are stored in the new video file at 236.

Once recording has begun at 218, 222, 232 or 236, the event capturing system displays the status of the system as "monitoring" on display 22 along with the name of the currently selected capture setup definition, the name of the current file which is being

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recorded, and the names of the currently selected event triggers. In addition, the images presently being captured during monitoring are displayed on display 22. This all occurs at 240. Thereafter, control is transferred to 260 to continue execution by the monitoring subsystem.

Referring to Figure 7C, continuation of the processing of execution by the monitoring subsystem will be described. While event capturing system continues to record images during monitoring, the user has the option of changing the setup, changing positions, changing the display, or setting event flags or line selects at 262. If the user decides to change the setup at 264, the event capturing system continues recording video images until the current video image file is completed or full, closes the current video image file, and stops recording at 266. Thereafter, control is returned to setup to allow the user to change the setup for the event capturing system provided that the user has the appropriate security clearance. If it is determined at 268 that the user decided to change the physical layout of the screen by selecting the "positions" key at 268, the current layout of the display 22 and the current setup definitions being used by the event capturing system are saved at 270 and control is returned to 206 to begin monitoring again. The user may also change the control panel displayed on display 22 to an icon by selecting a "▼" (i.e., down arrow key) at 272. If the "▼" key is selected at 272, the control panel is downsized to an icon at 274. The user may also set event flags by indicating the event flag to be set using input 20 at 276. Thereafter, event capturing system sets the event flags selected by the user at 278, and control is returned to block 206 to continue the monitoring process.

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After completing the change of positions at 268 and 270, the downsizing of the control panel at 272 and 274 or the setting of event flags at 276 and 278, control is transferred to Block 206.

5 The user can select a different predefined capture setup definition for the various environments by selecting the "line select" key at 280. As a result, the event capturing system continues recording images and storing those images in the current video
10 image file until the current video image file is complete or full, closes the current video image file and stops recording images at 282. Thereafter, control is returned to block 202 to continue the monitoring process.

15 Finally, the video image files recorded and stored during monitoring can be reviewed at 284. If the user selects the review option at 284, control is transferred to the playback subsystem.

20 If none of the options are selected by the user, the event capturing system returns control to Block 206 and continues the monitoring process.

Detailed Operation: Capturing Subsystem

Referring to Figure 7D-7E, the detailed operation of the capturing subsystem will now be
25 described. At the outset, the capturing subsystem displays an indication on display 22 that the event capturing system is in the capturing mode at 302. The event capturing system also displays an indication as to the source of the event, and deactivates the "Exit",
30 "Review", "Setup" and "Position" buttons. Still further, the event capturing system sets the number of video image files to be selected equal to the number of post-event video image files defined during setup, tags the current video image file being recorded as the
35 event file, and tags the pre-event files recorded during monitoring equal to the number of pre-event

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files to be permanently stored as pre-event video image files at 304. Thereafter, the event capturing system continues recording images and storing the images in the current video image file until the current video
5 image file is complete or full (i.e., t seconds of video image has been saved), closes the file and adds the designator "ev" to the end of the current video file name at 306.

A determination is then made at 308 as to
10 whether the number of post-event video image files to be captured is greater than zero. If it is determined at 308 that the appropriate number of post-event video image files has not been captured (i.e., number of files to be captured is greater than zero), a
15 determination is made at 310 as to whether a video image file is currently being recorded. If a video image file is currently being recorded, a determination is made as to how many seconds of video images have been saved in the current video image file at 312. If
20 the current video image file is full (i.e., t seconds of video image have been saved in the current video image file), the current video image file is closed and the capture parameter is decreased by one at 314. Thereafter, control is returned to block 308 to
25 continue the capture process.

If it is determined at 312 that the current video image file is not full, a determination is made at 316 as to whether a new event has occurred. If a new event has occurred, the event capturing system
30 displays an indication on display 22 as to the location of the source of the event, sets the capture parameter equal to the number of files to be included in the post-event file sequence, flags the current video image file as an event file, continues recording until the
35 current video image file is full (i.e., t seconds of video image have been saved in the current video image file), closes the file and adds the identifier "ev" to

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the end of the file name at 318. If a new trigger has not occurred, control is returned to block 308 to continue the capture process.

If it is determined at 310 that a video image
5 file was not currently being recorded, a new video image file is opened, the new file is identified by the time of the opening or creation of the file, the new file is tagged as a post-event file, and the event capturing system begins recording images in the new
10 video image file at 320.

If it is determined at block 308 that the capture parameter is not greater than zero (i.e., the number of post-event video image files as defined during setup have been captured), the event capturing
15 system 16 directs where the pre-event, event and post-event video image files are to be permanently stored at 330 based on the predefined capture setup definition. If the predefined capture setup definition indicates that the pre-event, event and post-event video image
20 files are to be stored in permanent storage at 332, the event capturing system changes all video image files tagged as pre-event, event and post-event files in the working subdirectory to permanent in the same subdirectory at 334. If the predefined capture setup
25 definition indicates that the captured video image files are to be archived at 336, all tagged pre-event, event and post-event video image files are copied into permanent storage at 338.

If the predefined capture setup definition
30 indicates that the pre-event, event and post-event video image files are to be merged at 340, the files are recorded to working storage, merged and then stored in permanent storage. As a result, all video image files tagged as pre-event, event or post-event files
35 are merged into a single storage file and the single storage file is identified by the name of the first video image file at 342. Thereafter, the merged file

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is copied from the working storage to permanent storage at 344.

Regardless of which option is selected for permanently recording the pre-event, event and post-event video image files, all video image files recorded during monitoring that are older than the oldest pre-event video image file are deleted from working storage at 346. In addition, all video image files tagged as pre-event, event or post-event files are deleted from working storage and the name and path of the last event file created is saved for playback at 346. Thereafter, the event capturing system displays an indication on display 22 that the system is in "recording" mode, removes all "X" from the display indicating the sources of any events and activates the "Exit", "Review", "Setup" and "Position" buttons at 348.

Thereafter, control is transferred to block 206 to return control to the monitoring subsystem.

Detailed Operation: Playback Subsystem

Referring to Figure 7F, the detailed operations of the playback subsystem will now be described. The user can select the playback feature by selecting the "review" button. If the user has selected to review, the event capturing system will complete recording the current video image file, close the current video image file and stop recording images at 400. A determination is then made at 402 as to whether an event occurred. If an event occurred, the event capturing system changes control so that the currently selected permanent storage subdirectory will be used at 404. Thereafter, the video image file having the indicator "ev" for the last event captured is selected by the event capturing system as the file to be reviewed at 406.

If it is determined at 402 that an event has not occurred, the user then selects the video file

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containing the pre-event, event or post-event video images for the desired event from the directory listings at 408.

Once the video image sequence or footage for the desired event has been selected, the user then has a number of options for reviewing the event at 410. The user may select to end the review process by selecting the "Close" key at 412. If the "Close" key is selected, control is returned to block 206 and the monitoring subsystem. If the user selects the "Files" key at 414, the user can then select a new video image sequence file to review at 416 and control is returned to Block 410 to permit the user to select another option. The user may also print one or more frames of the video image sequence by selecting the "Print" key at 418 which causes the selected frame to be printed on a printer selected during setup at 420.

In addition, the user may also set the playback rate as well as the position in the video image sequence to begin the review process. If the user selects the playback rate slide bar at 422, the user then can select the playback rate in the range from 1 frame per second to 60 frames per second at 424. Similarly, if the user selects the option of indicating a random position to begin the review process at 426, the user can select the new position for beginning the review process at 428.

Finally, the user may also select from a number of standard keys for controlling the playback of the captured video image sequence. These options which may be selected using the standard keys from a VCR recorder include "<<", "<", "■", "||", ">" and ">>" at 430, 434, 438, 442, 446 and 450, respectively. As will be understood by those having skill in the art, election of these options result in playing the video in reverse at twice the selected playback rate, playing the video in reverse at the selected playback rate,

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stopping the video, pausing the video, playing the
video forwards at the selected playback rate and
playing the video forwards at twice the selected
playback rate at 432, 436, 440, 444, 448 and 452,
5 respectively.

In the drawings and specification, there have
been disclosed typical preferred embodiments of the
invention and, although specific terms are employed,
they are used in a generic and descriptive sense only
10 and not for purpose of limitation, the scope of the
invention being set forth in the following claims.

THAT WHICH IS CLAIMED:

1. An event capturing system comprising:
image capturing means for capturing a
plurality of images of an operational environment;
circular storage means, having a first
5 predetermined length, and responsive to the image
capturing means, for continuously recording a first
predetermined number of the plurality of images of the
operational environment captured by the image capturing
means;
10 event triggering means, responsive to
occurrence of an event in said operational environment,
for signalling the occurrence of an event in said
operational environment; and
noncircular storage means, having a second
15 predetermined length, and responsive to the image
capturing means and the event triggering means, for
continuously recording a second predetermined number of
the plurality of images of the operational environment
captured by the image capturing means;
20 wherein the first predetermined number is
unrelated to the second predetermined number.

2. The event capturing system of Claim 1
wherein the plurality of images comprises a first image
sequence having a plurality of images and a second
25 image sequence having a plurality of images; and
wherein the first image sequence is recorded in the
circular storage means and the second image sequence is
recorded in the noncircular storage means.

3. The event capturing system of Claim 1
30 further comprising:
second image capturing means for capturing a
second plurality of images of an operational
environment;

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second circular storage means, having a first predetermined length, and responsive to the second image capturing means, for continuously recording a third predetermined number of the second plurality of
5 images of the operational environment captured by the second image capturing means;

second event triggering means, responsive to occurrence of a second event in said operational environment, for signalling the occurrence of a second
10 event in said operational environment; and

second noncircular storage means, having a fourth predetermined length, and responsive to the second image capturing means and the second event triggering means, for continuously recording a fourth
15 predetermined number of the second plurality of images of the operational environment captured by the second image capturing means;

wherein the third predetermined number is unrelated to the fourth predetermined number.

20 4. The event capturing system of Claim 1 further comprising:

second circular storage means, having a first predetermined length, and responsive to the image capturing means, for continuously recording a third
25 predetermined number of the plurality of images of the operational environment captured by the image capturing means;

second event triggering means, responsive to occurrence of a second event in said operational
30 environment, for signalling the occurrence of a second event in said operational environment; and

second noncircular storage means, having a fourth predetermined length, and responsive to the image capturing means and the second event triggering
35 means, for continuously recording a fourth predetermined number of the plurality of images of the

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operational environment captured by the image capturing means;

wherein the third predetermined number is unrelated to the fourth predetermined number.

5 5. The event capturing system of Claim 1 wherein the images captured by said image capturing means are video images.

6. The event capturing system of Claim 1 wherein the images captured by said image capturing
10 means are audio images.

7. The event capturing system of Claim 1 wherein the image capturing means comprises at least one video camera.

8. The event capturing system of Claim 1
15 further comprising permanent storage means for storing the first predetermined number of the plurality of images and the second predetermined number of the plurality of images therein.

9. The event capturing system of Claim 8
20 further comprising communication means connected to said circular storage means and to said noncircular storage means, wherein the permanent storage means is located a location remote to the circular storage means and to the noncircular storage means and is connected
25 to the communication means to permit the first predetermined number of the plurality of images and the second predetermined number of the plurality of images to be stored in the remotely located permanent storage means.

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10. The event capturing system of Claim 1 wherein the event triggering means comprises at least one discrete pulse triggering device.

11. The event capturing system of Claim 1
5 wherein the event triggering means comprises at least one analog triggering device.

12. The event capturing system of Claim 1 further comprising image display means for concurrently displaying the images captured by the image capturing
10 means.

13. An event capturing system comprising:
image capturing means for capturing a plurality of images of an operational environment;
circular storage means, responsive to the
15 image capturing means, for continuously circularly recording images of the operational environment captured by the image capturing means;
event triggering means, responsive to occurrence of an event in said operational environment,
20 for signalling the occurrence of an event in said operational environment; and
converting means, responsive to the image capturing means and the event triggering means, for converting the circular storage means to noncircular
25 storage means to enable the continuous noncircular recording of images of the operational environment captured by the image capturing means.

14. The event capturing system of Claim 13 wherein the circular storage means has a first
30 predetermined length and the noncircular storage means has a second predetermined length; and wherein the first predetermined length is unrelated to the second predetermined length.

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15. The event capturing system of Claim 13 further comprising:

second image capturing means for capturing a second plurality of images of an operational
5 environment;

second circular storage means, responsive to the second image capturing means, for continuously circularly recording images of the operational environment captured by the second image capturing
10 means;

second event triggering means, responsive to occurrence of a second event in said operational environment, for signalling the occurrence of a second event in said operational environment; and

15 second converting means, responsive to the second image capturing means and the second event triggering means, for converting the second circular storage means to a second noncircular storage means to enable the continuous noncircular recording of images
20 of the operational environment captured by the second image capturing means.

16. The event capturing system of Claim 15 wherein the second circular storage means has a third predetermined length and the second noncircular storage
25 means has a fourth predetermined length; and wherein the third predetermined length is unrelated to the fourth predetermined length.

17. The event capturing system of Claim 13 further comprising:

30 second circular storage means, responsive to the image capturing means, for continuously circularly recording images of the operational environment captured by the image capturing means;

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second event triggering means, responsive to occurrence of a second event in said operational environment, for signalling the occurrence of a second event in said operational environment; and

5 second converting means, responsive to the image capturing means and the second event triggering means, for converting the second circular storage means to a second noncircular storage means to enable the continuous noncircular recording of images of the
10 operational environment captured by the image capturing means.

18. The event capturing system of Claim 17 wherein the second circular storage means has a third predetermined length and the second noncircular storage
15 means has a fourth predetermined length; and wherein the third predetermined length is unrelated to the fourth predetermined length.

19. The event capturing system of Claim 13 wherein the images captured by said image capturing
20 means are video images.

20. The event capturing system of Claim 13 wherein the images captured by said image capturing means are audio images.

21. An event capturing method which executes
25 on a computer system comprising the steps of:
 capturing a plurality of images of an operational environment;
 continuously circularly recording a first predetermined number of the captured plurality of
30 images of the operational environment;
 identifying the occurrence of an event in the operational environment; and

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continuously noncircularly recording a second predetermined number of the captured plurality of images of the operational environment in response to the identified event;

5 such that the first predetermined number is unrelated to the second predetermined number.

22. The event capturing method of Claim 21 further comprising the steps of:

10 capturing a second plurality of images of the operational environment;

 continuously circularly recording a third predetermined number of the captured second plurality of images of the operational environment;

15 identifying the occurrence of a second event in the operational environment; and

 continuously noncircularly recording a fourth predetermined number of the captured second plurality of images of the operational environment in response to the identified second event;

20 such that the third predetermined number is unrelated to the fourth predetermined number.

23. The event capturing method of Claim 21 further comprising the steps of:

25 continuously circularly recording a third predetermined number of the captured plurality of images of the operational environment;

 identifying the occurrence of a second event in the operational environment; and

30 continuously noncircularly recording a fourth predetermined number of the captured plurality of images of the operational environment in response to the identified second event;

 such that the third predetermined number is unrelated to the fourth predetermined number.

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24. The event capturing method of Claim 21 wherein said continuously noncircularly recording step is followed by the step of: permanently storing the first predetermined number of the plurality of images and the second predetermined number of the plurality of images.

25. The event capturing method of Claim 21 further comprising the step of concurrently displaying the captured images on display means.

10 26. An event capturing method which executes on a computer system including circular storage means comprising the steps of:

capturing a plurality of images of an operational environment;

15 continuously circularly recording in the circular storage means the captured images of the operational environment;

identifying the occurrence of an event in the operational environment; and

20 converting the circular storage means to noncircular storage means to enable the continuous noncircular recording of the captured images of the operational environment in response to the identified event.

25 27. The event capturing method of Claim 26 wherein the step of continuously circularly recording in a circular storage means comprises the step of continuously circularly recording in the circular storage means a first predetermined number of the captured plurality of images.

28. The event capturing method of Claim 27 wherein said converting step is followed by the step of continuously recording in the noncircular storage means

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a second predetermined number of the captured plurality of images of the operational environment; such that the first predetermined number is unrelated to the second predetermined number.

5 29. The event capturing method of Claim 26 further comprising the steps of:

 capturing a second plurality of images of an operational environment;

 continuously circularly recording in the
10 second circular storage means the captured second plurality of images of the operational environment;

 identifying the occurrence of a second event in the operational environment; and

 converting the second circular storage means
15 to a second noncircular storage means to enable the continuous noncircular recording of the captured images of the operational environment in response to the identified second event.

 30. The event capturing method of Claim 29
20 wherein the step of continuously circularly recording the captured second plurality of images comprises the step of continuously recording in the second circular storage means a third predetermined number of the captured second plurality of images.

25 31. The event capturing method of Claim 30 wherein the converting step is followed by the step of continuously recording in the second noncircular storage means a fourth predetermined number of the captured second plurality of images of the operational
30 environment; such that the third predetermined number is unrelated to the fourth predetermined number.

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32. The event capturing method of Claim 26 further comprising the steps of:
- continuously circularly recording in a second circular storage means captured images of the
 - 5 operational environment;
 - identifying the occurrence of a second event in the operational environment; and
 - converting the second circular storage means to a second noncircular storage means to enable the
 - 10 continuous noncircular recording of the captured images of the operational environment in response to the identified second event.

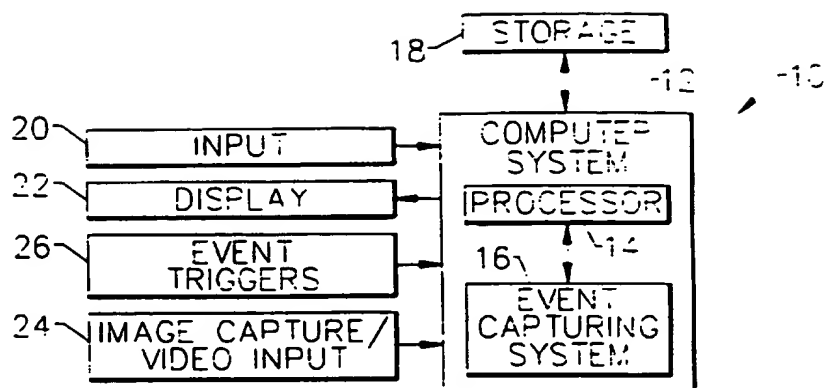


FIG. 1.

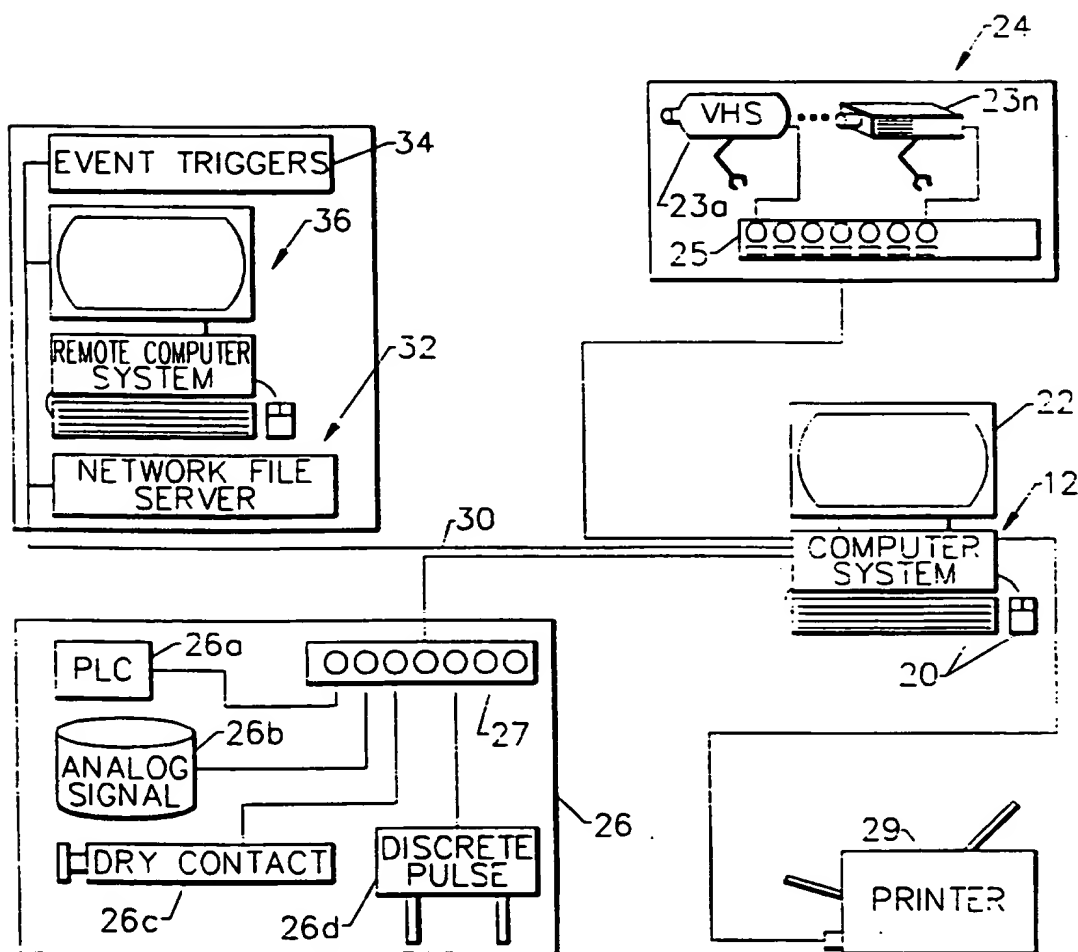


FIG. 2.

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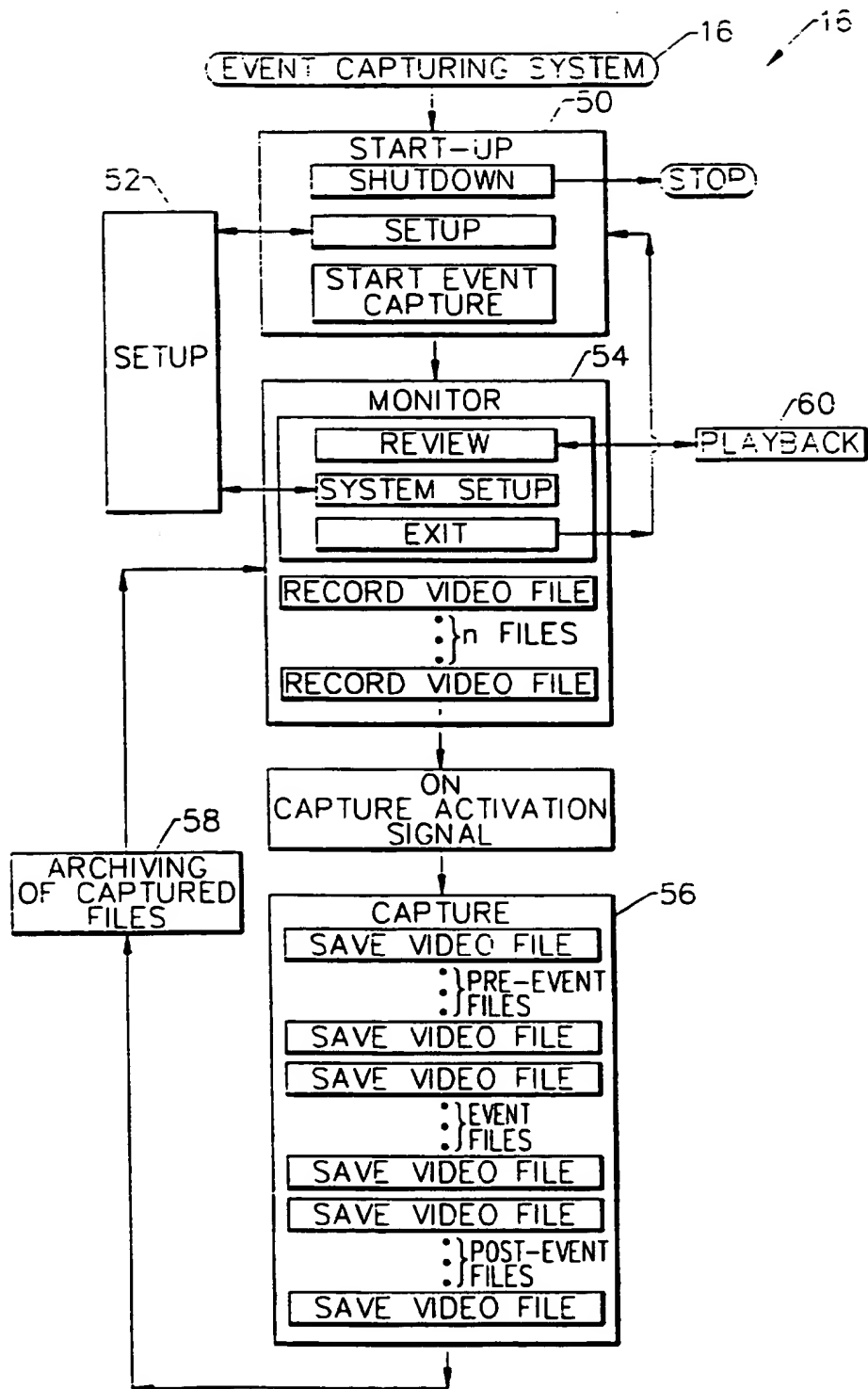


FIG. 3.

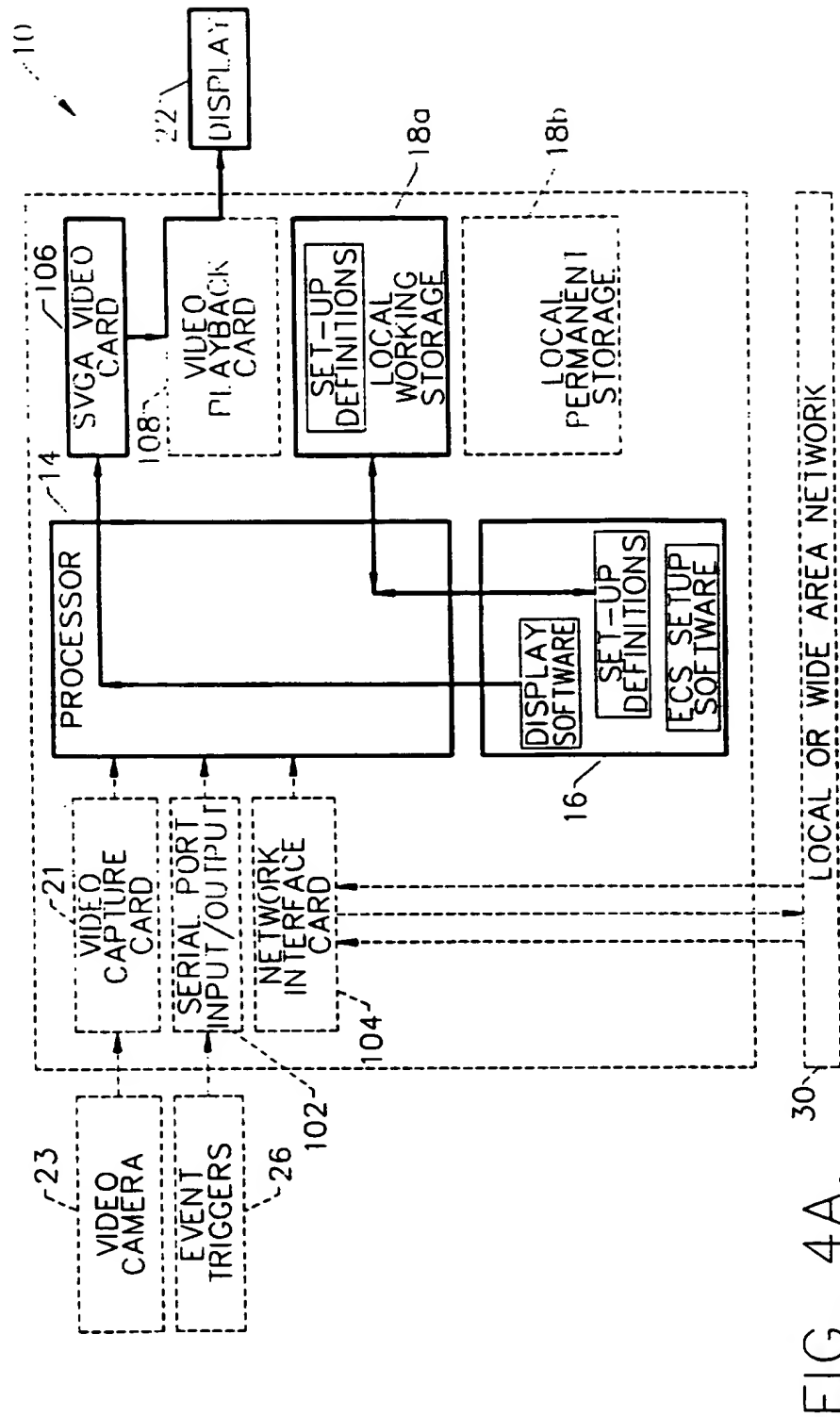


FIG. 4A.

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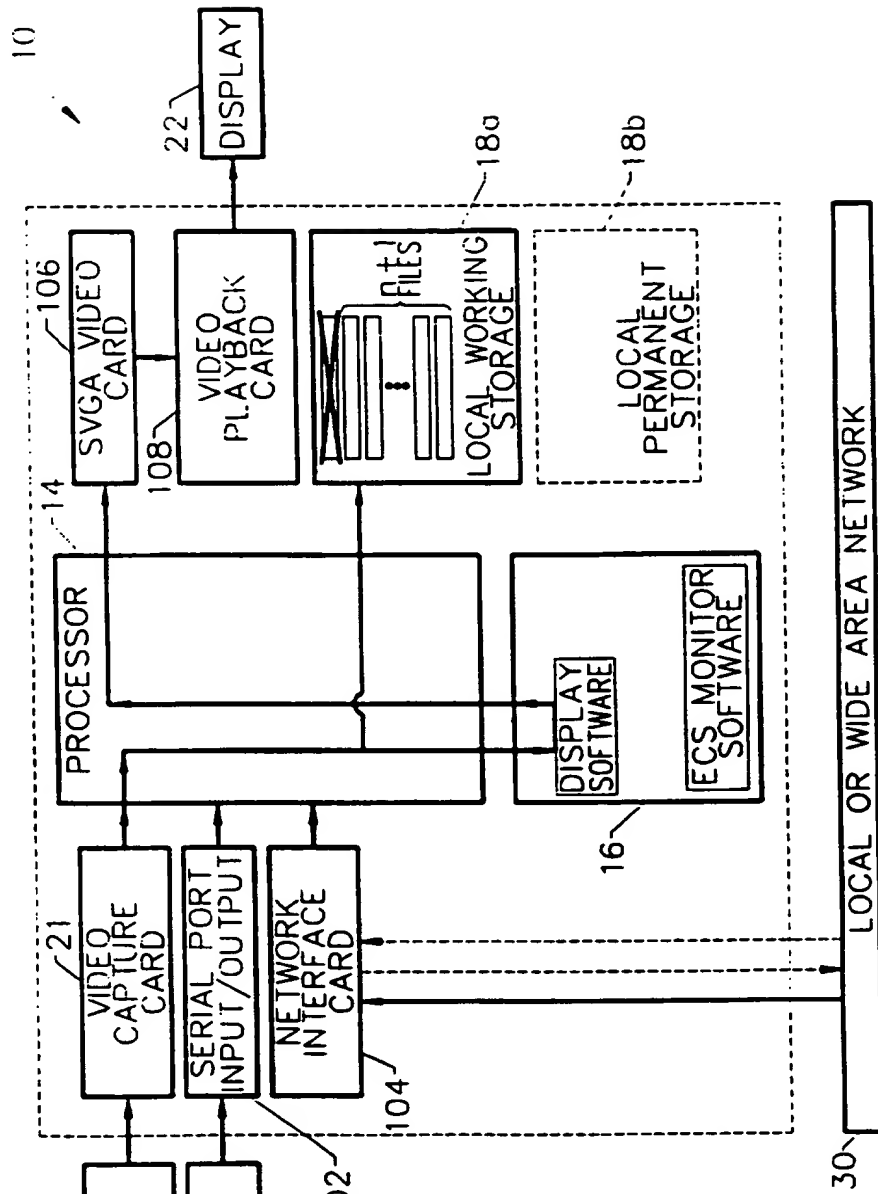


FIG. 4B.

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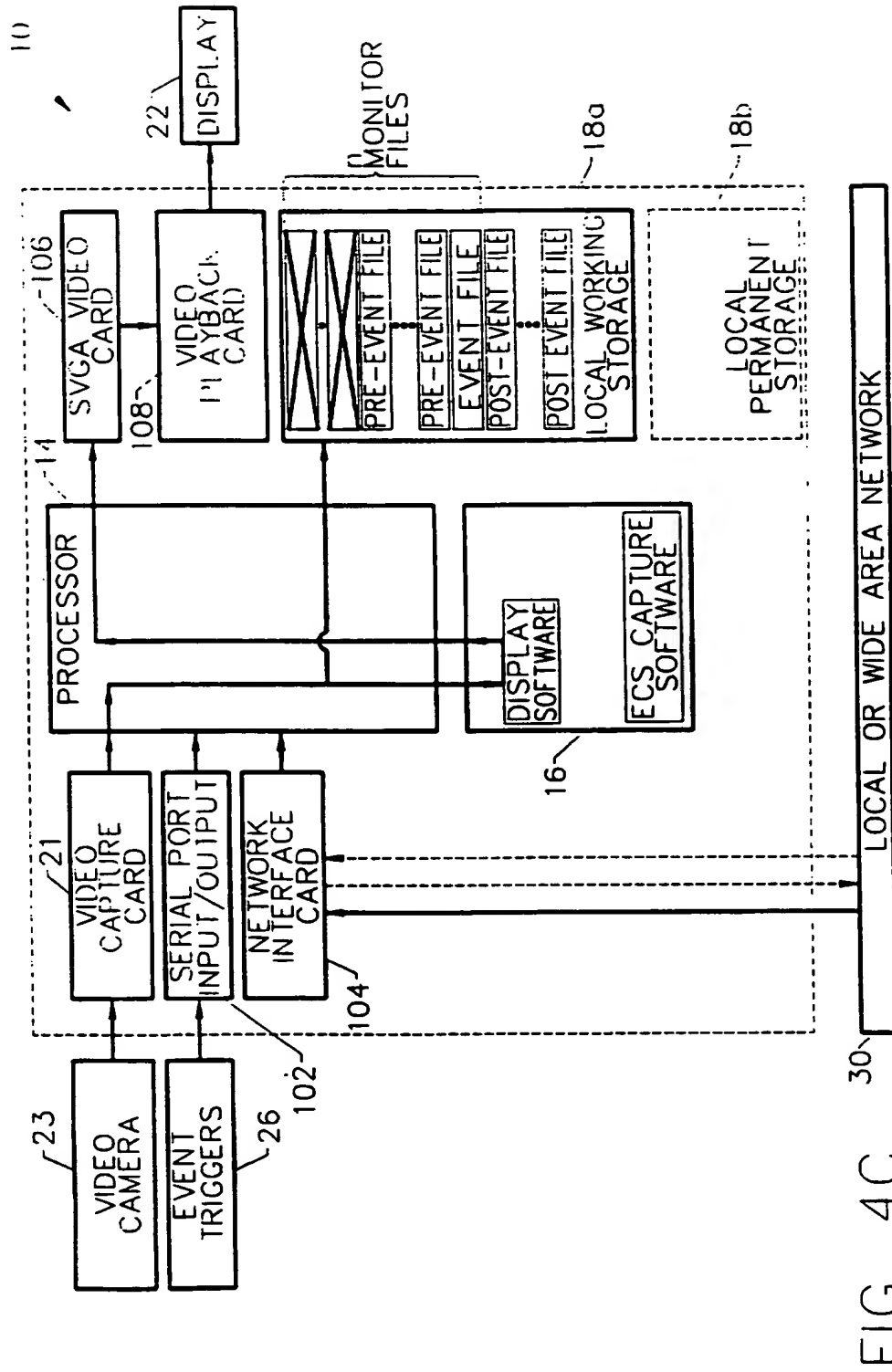


FIG. 4C.

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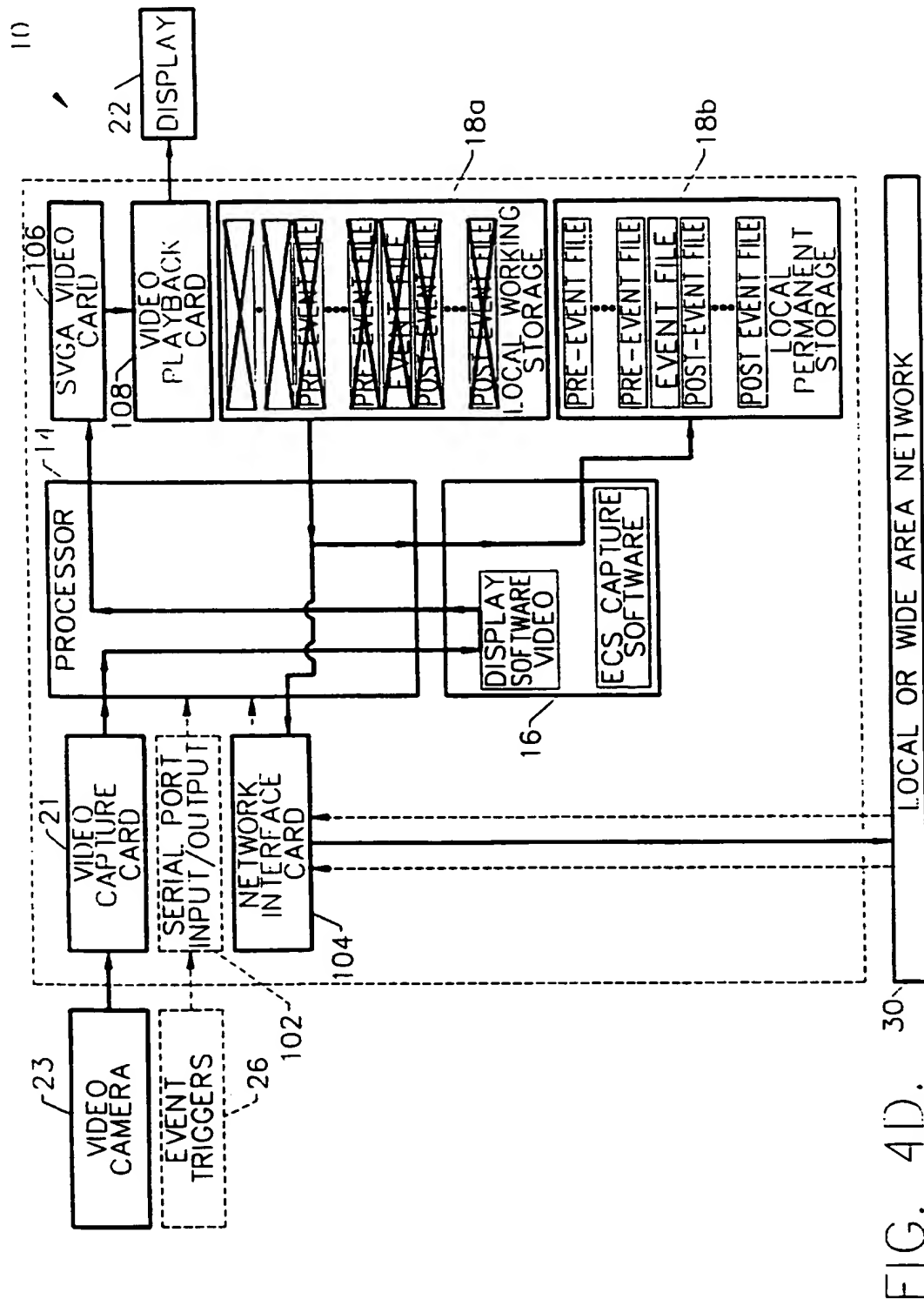


FIG. 4D.

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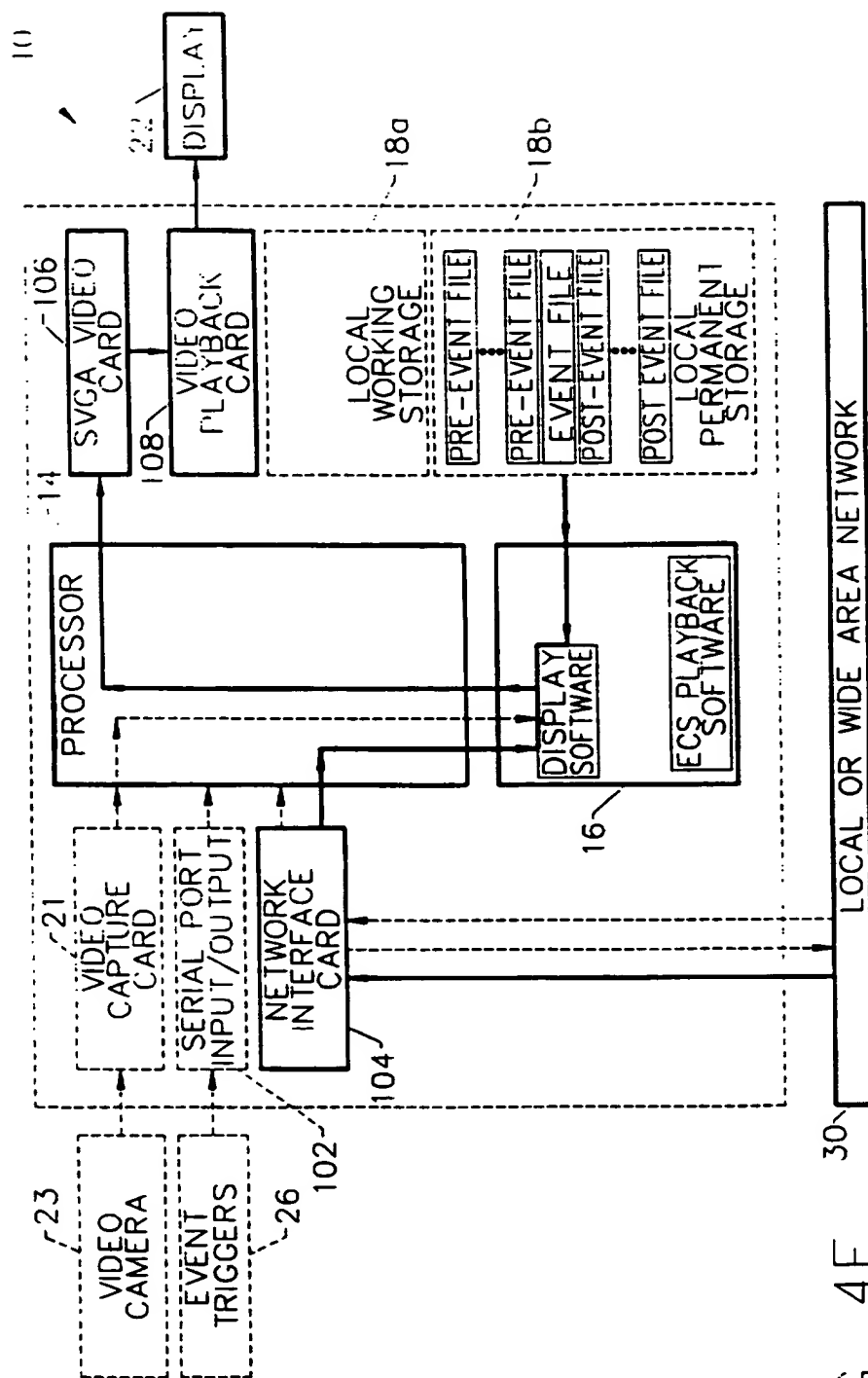
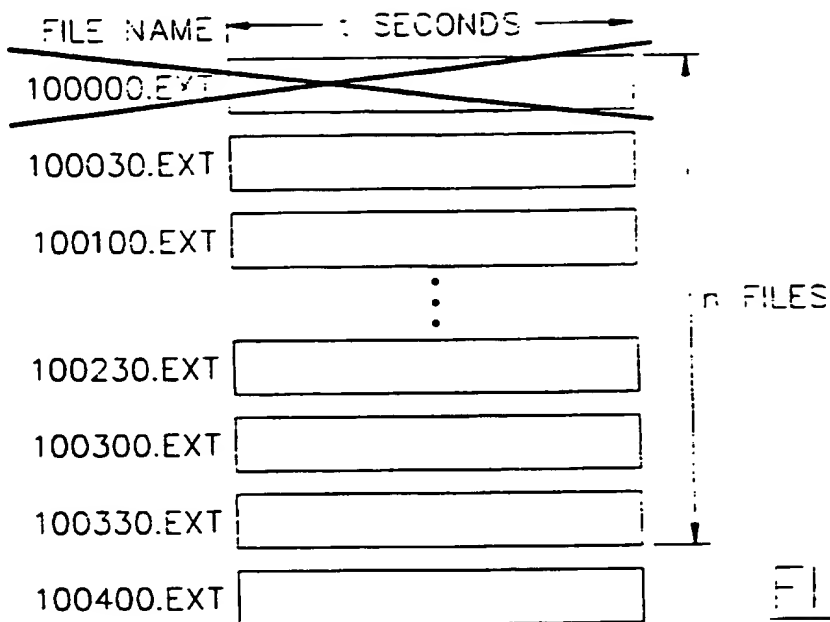
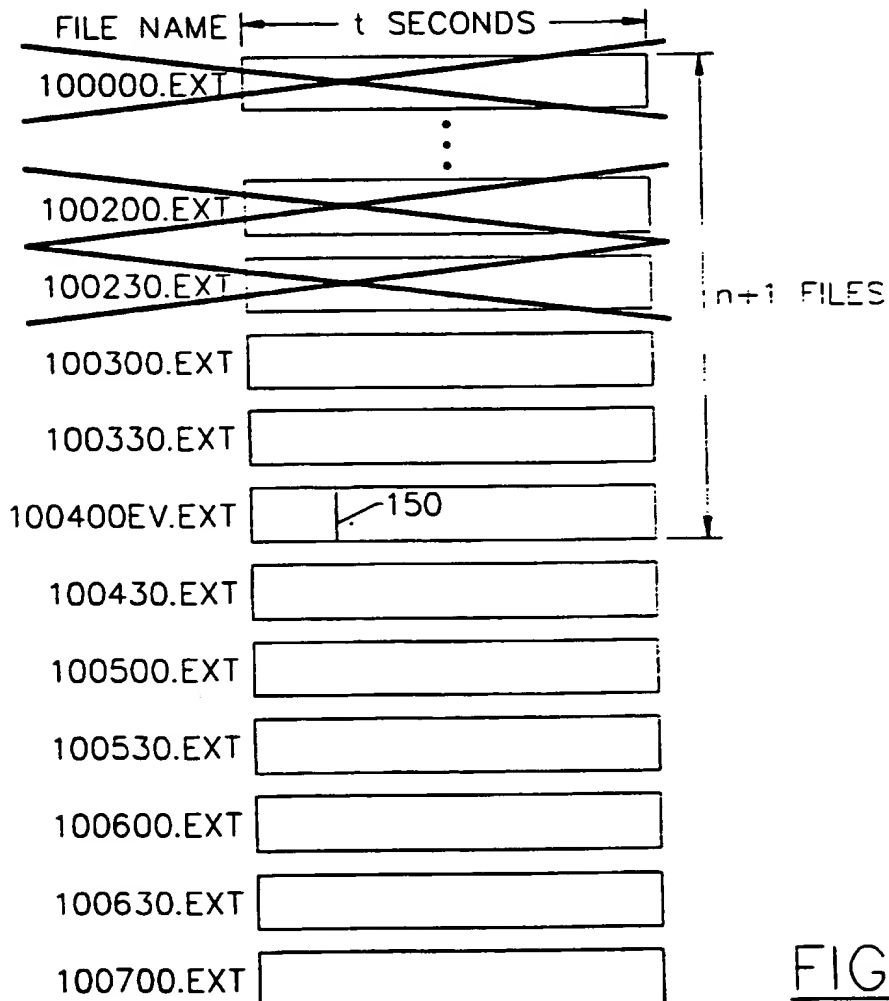
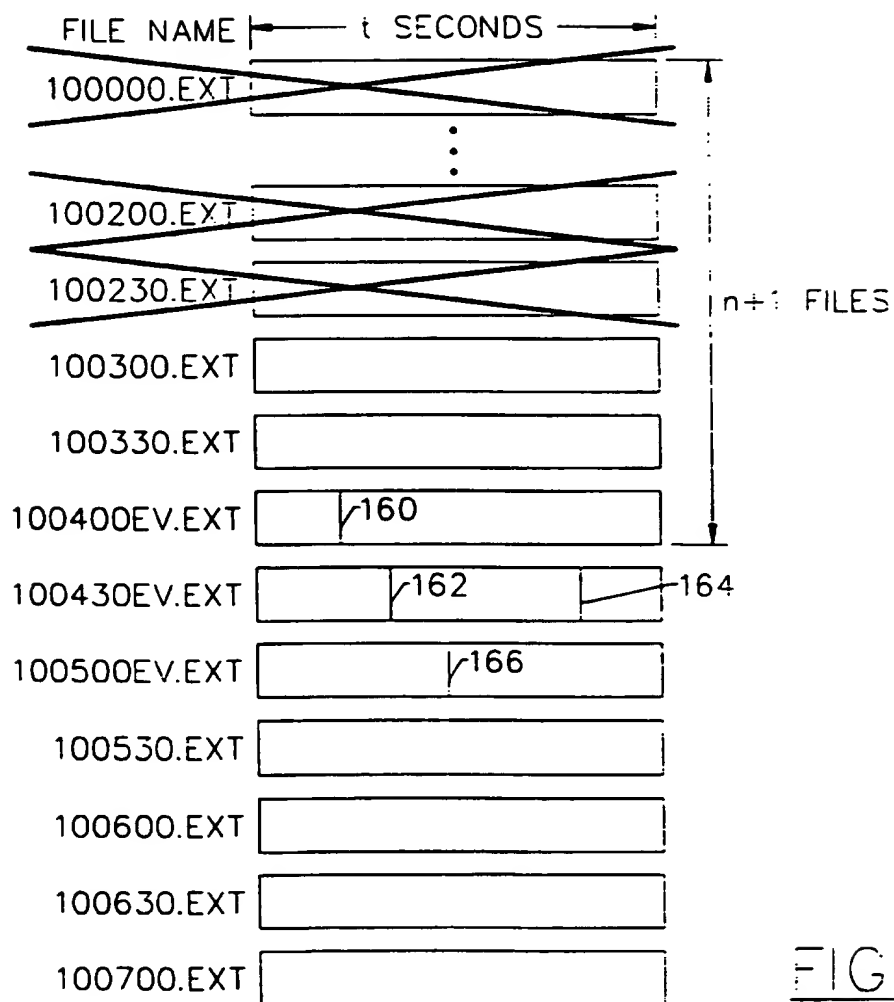


FIG. 4E.

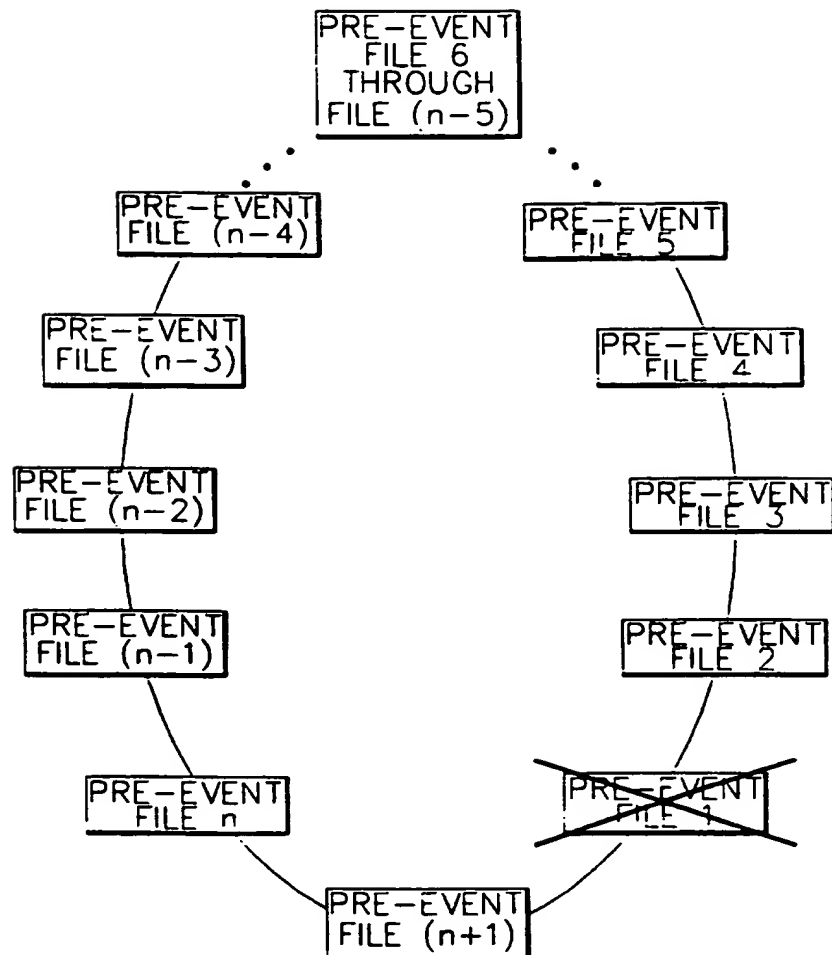
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FIG. 5A.FIG. 5B.

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FIG. 5C.

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FIG. 6A.

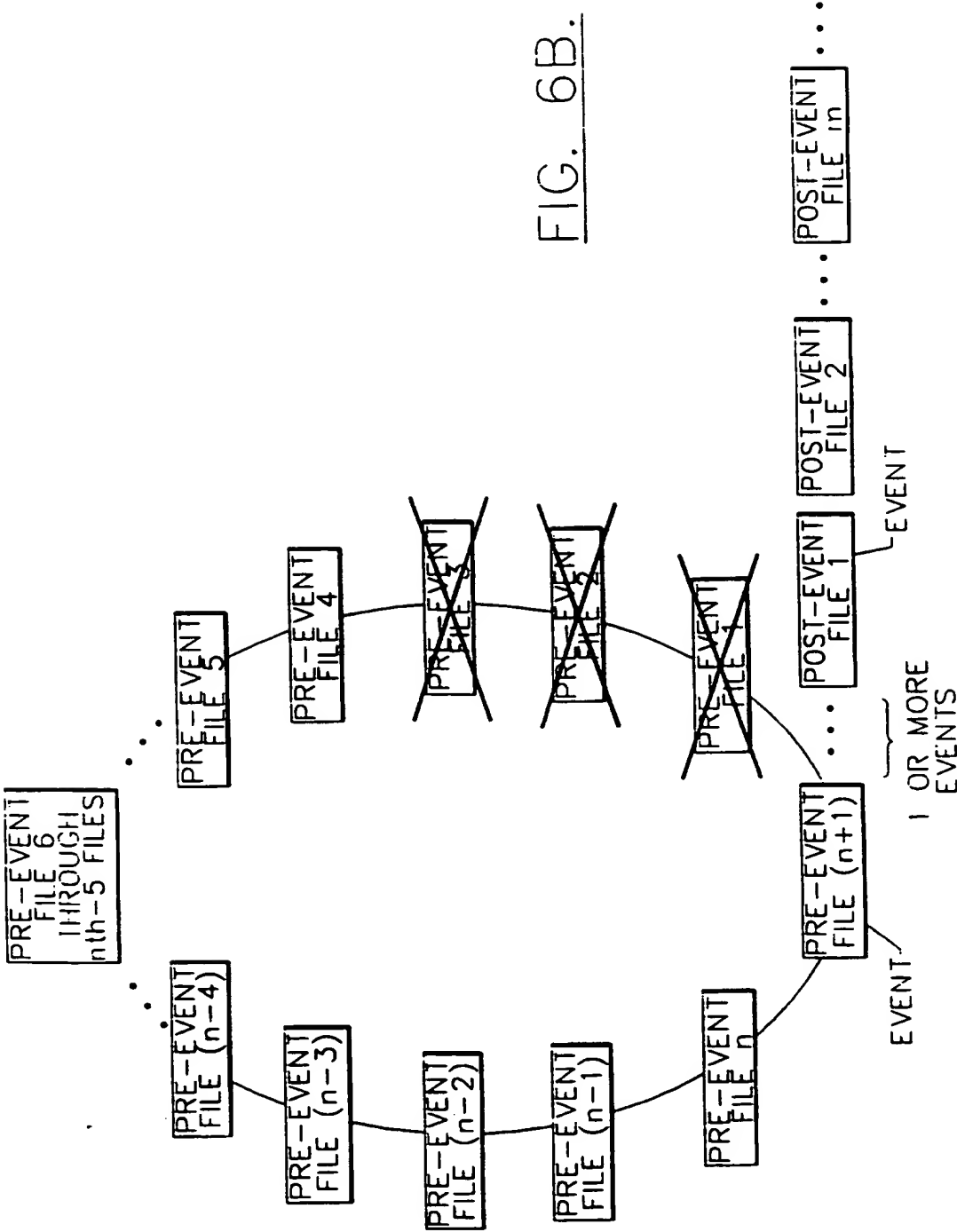
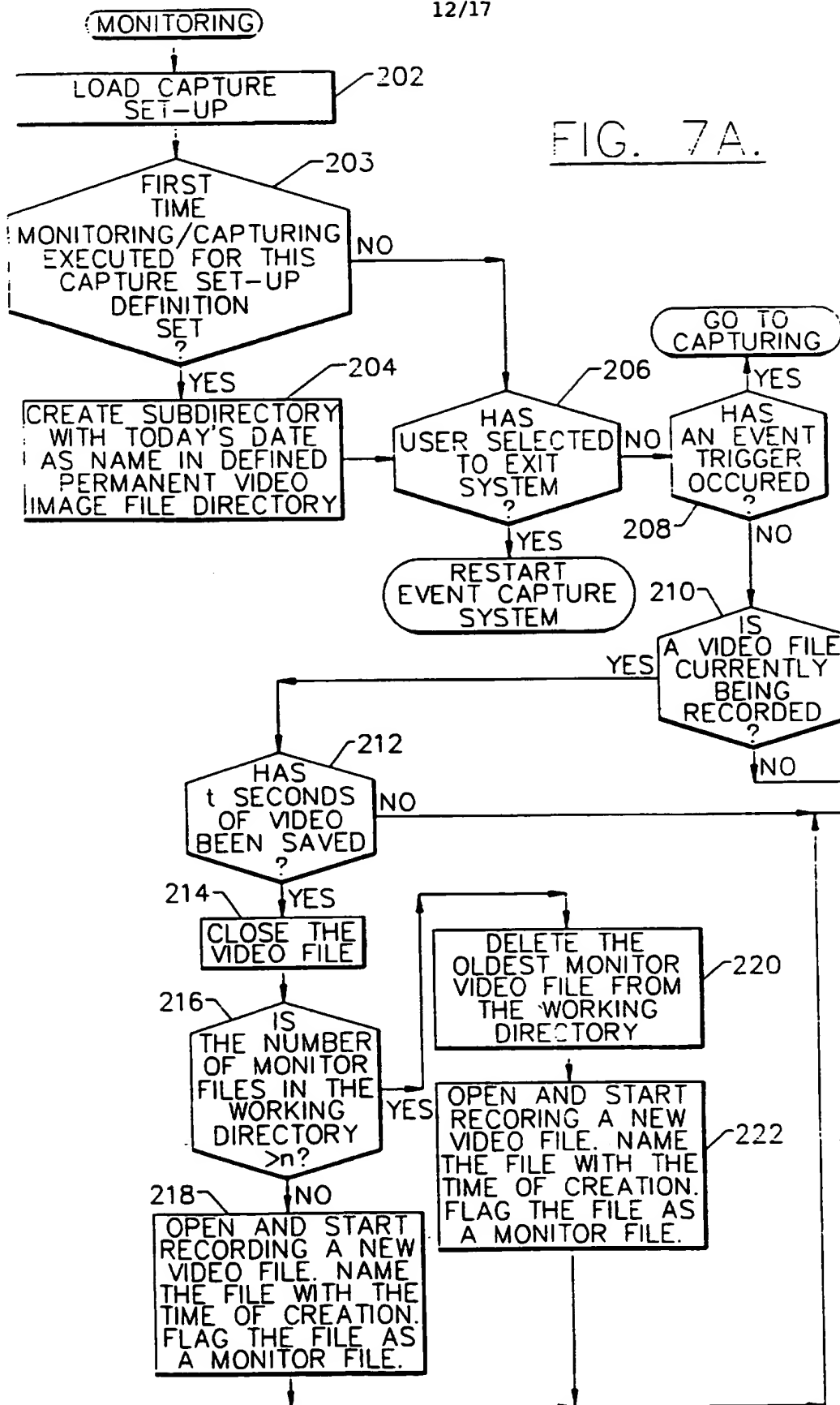


FIG. 6B.

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FIG. 7A.



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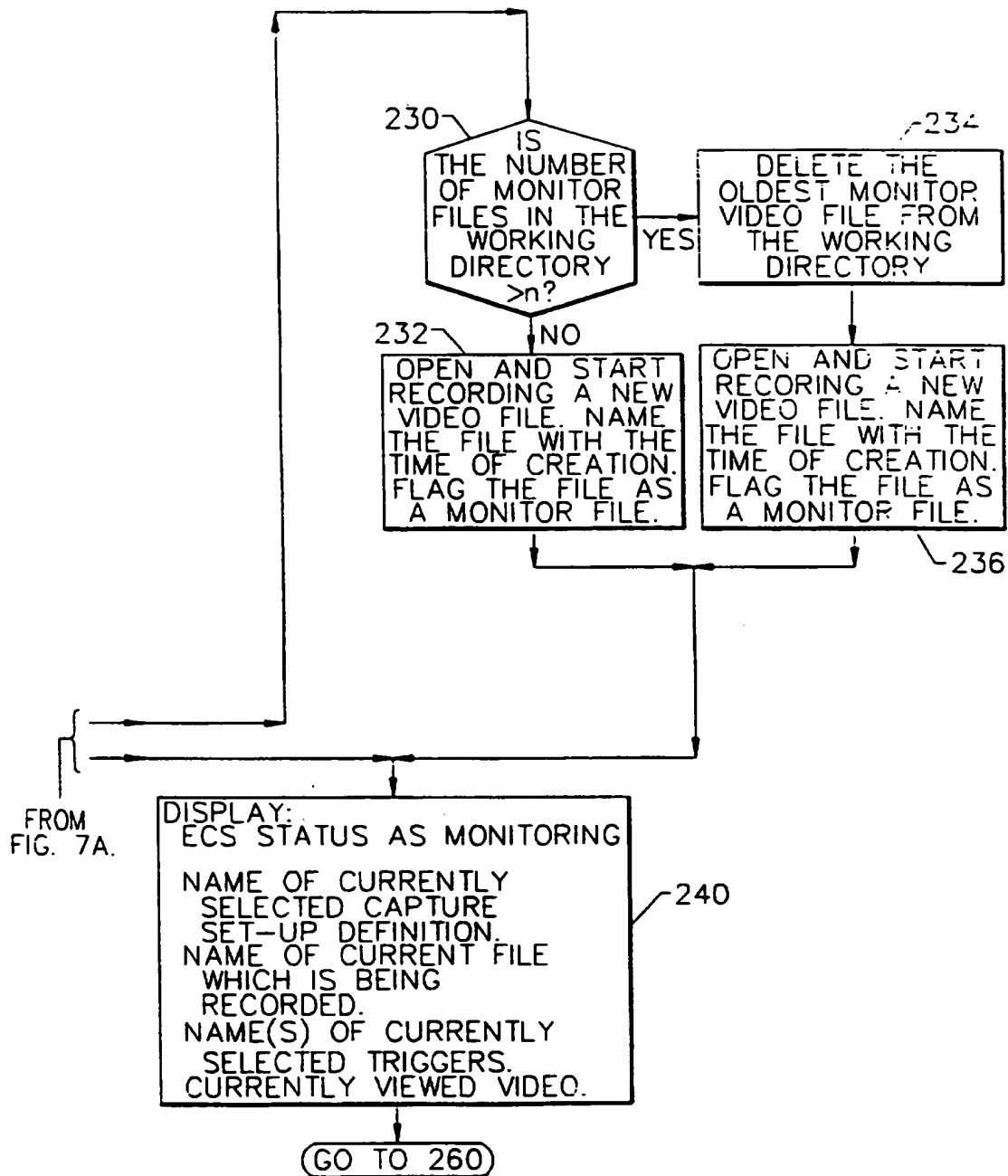


FIG. 7B.

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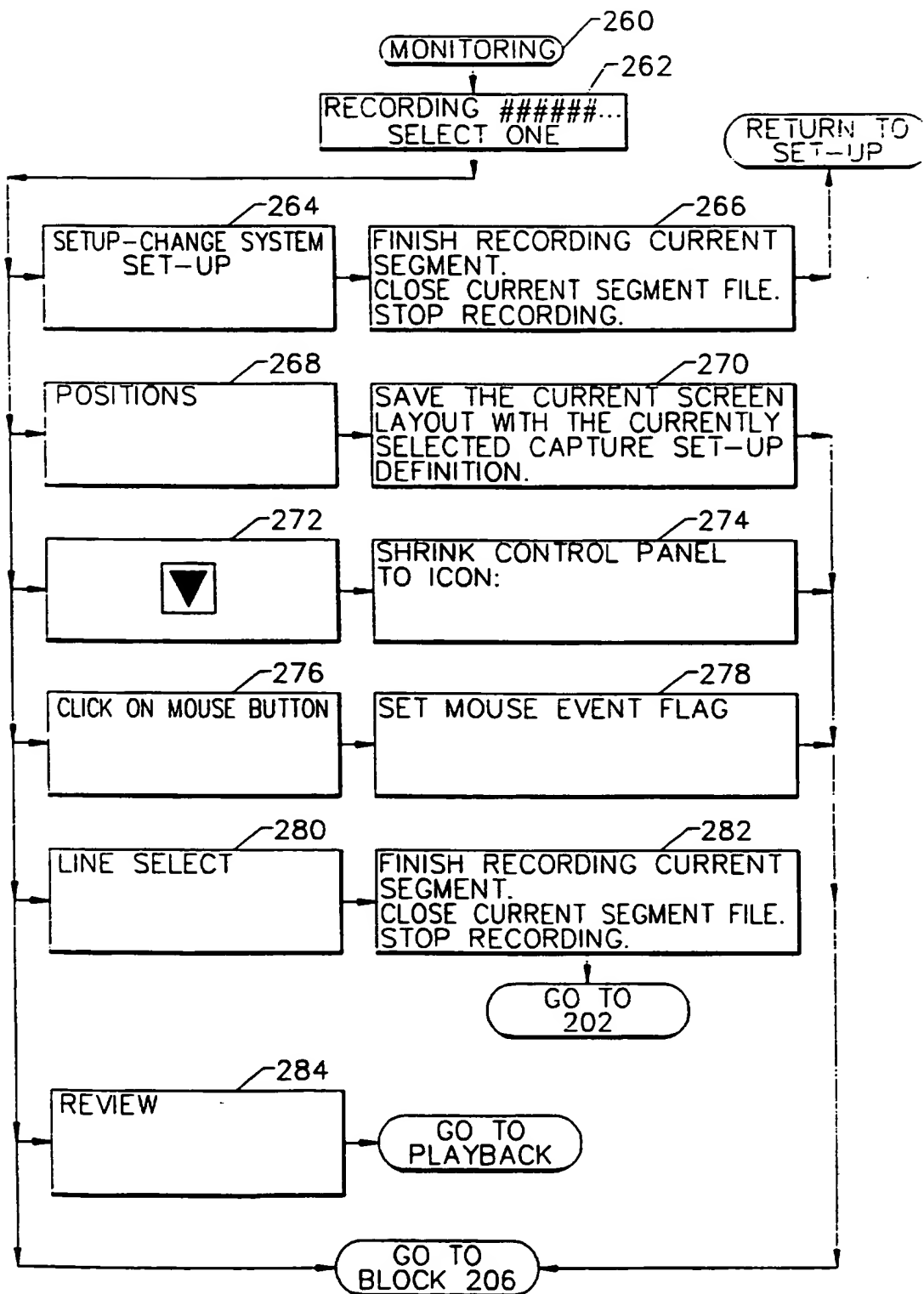
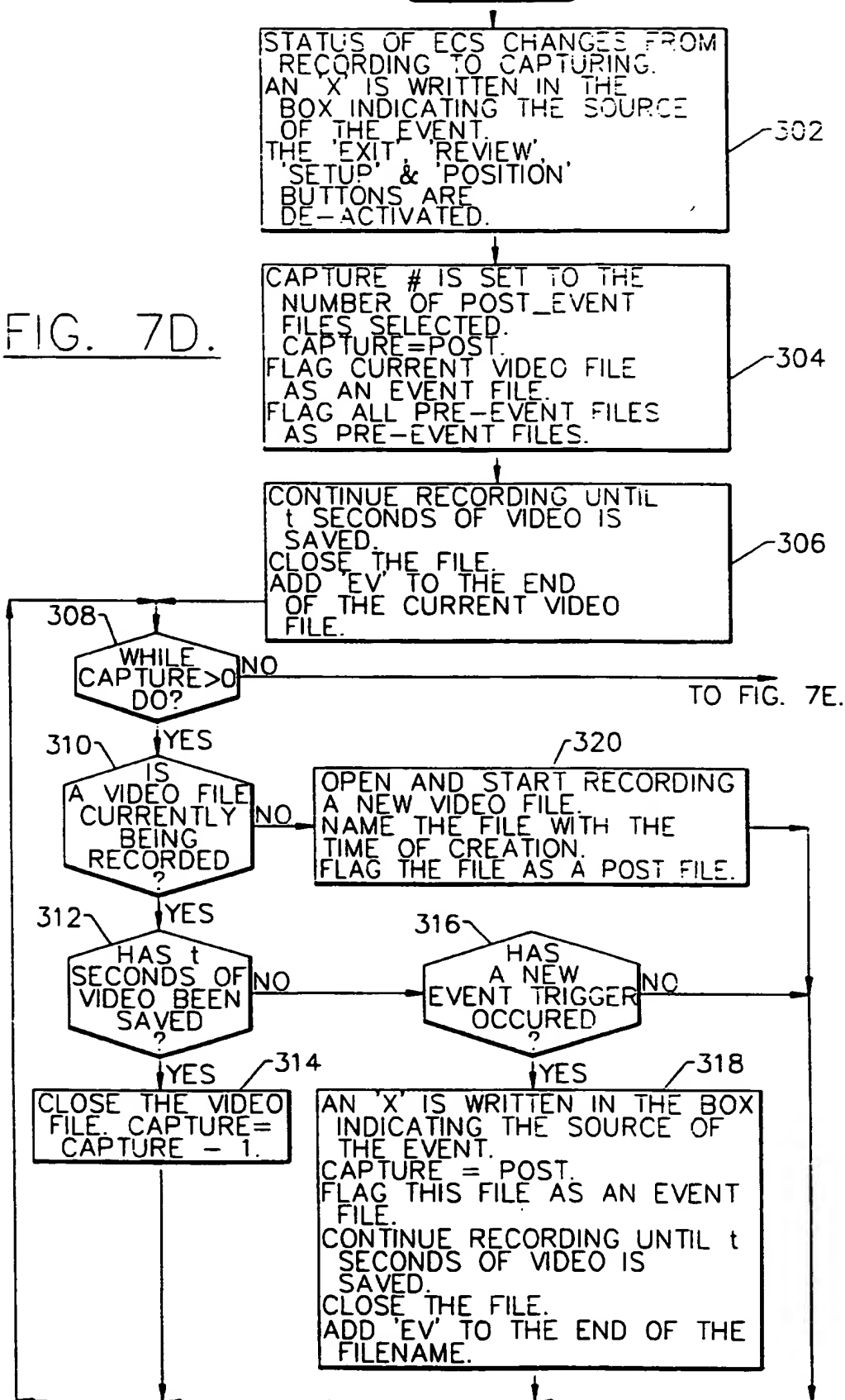


FIG. 7C.

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(CAPTURING) 300

FIG. 7D.



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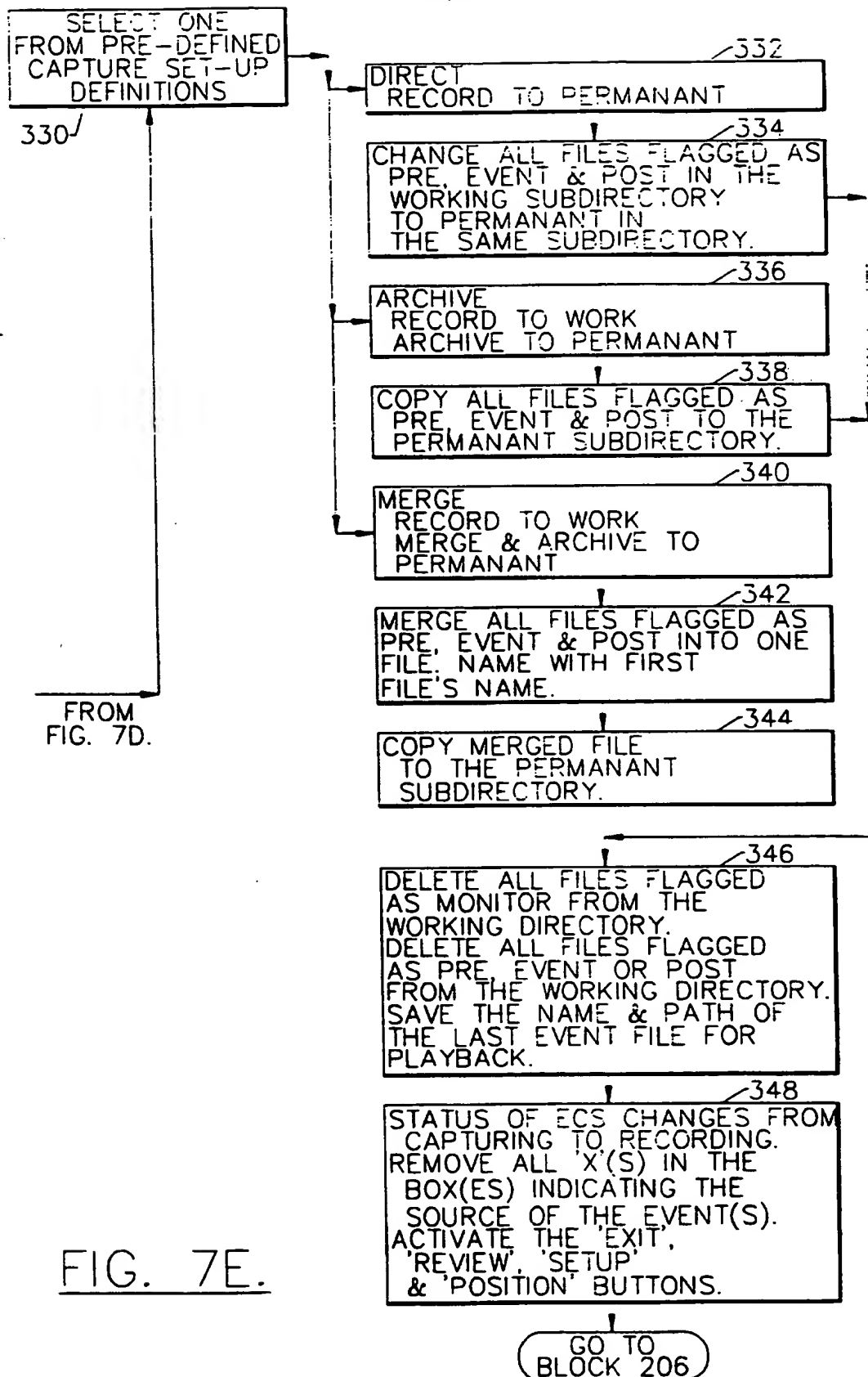
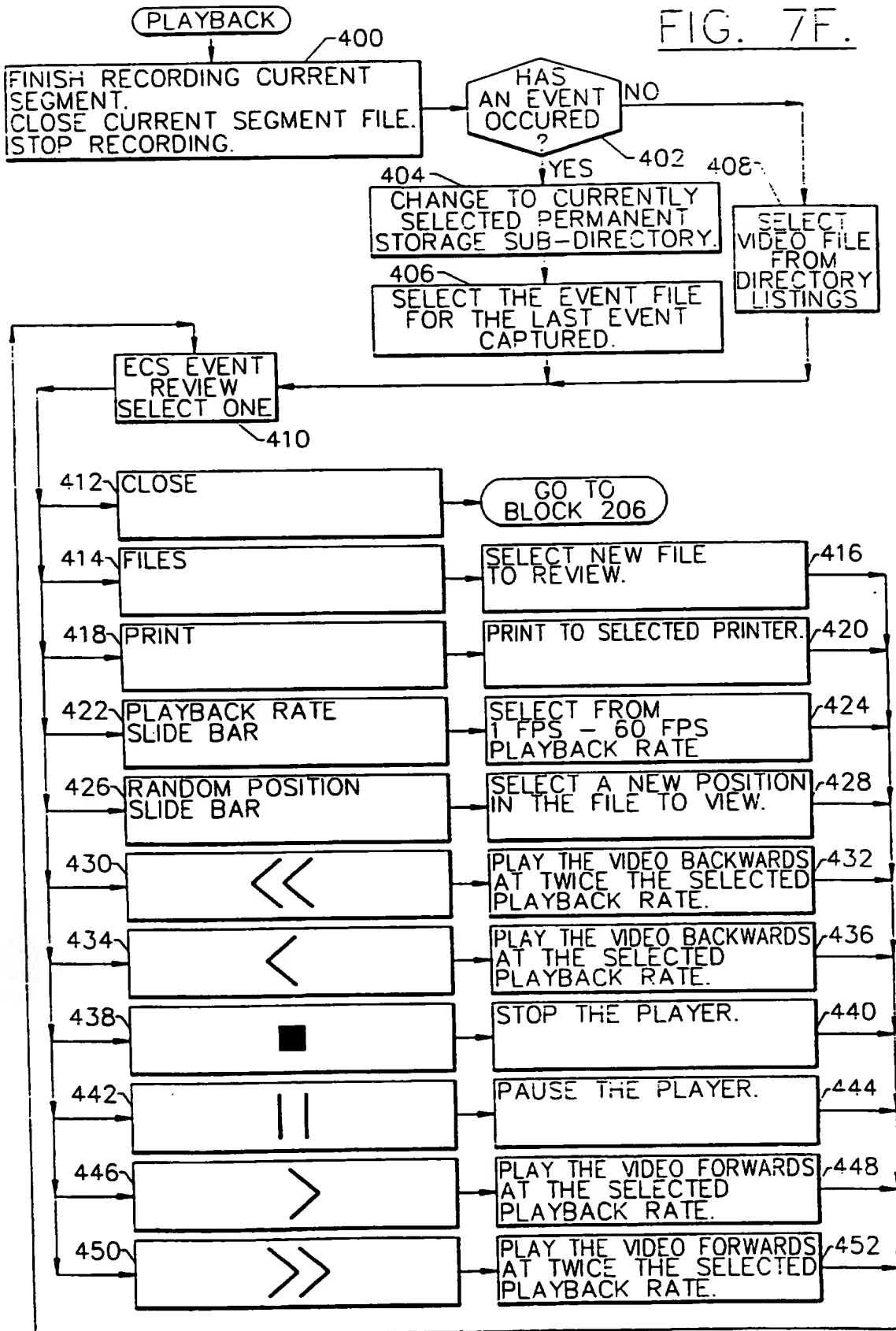


FIG. 7E.

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FIG. 7F.



INTERNATIONAL SEARCH REPORT

national Application No
PCT/US 96/02912A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G08B15/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB,A,2 250 156 (CHUBB ELECTRONICS) 27 May 1992 see abstract ---	1,2,5-7, 10-14, 19-21, 24-28
A	US,A,5 229 850 (KEIICHI TOYOSHIMA) 20 July 1993 see abstract -----	1,8,9

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

18 June 1996

Date of mailing of the international search report

08.07.96

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Sgura, S

INTERNATIONAL SEARCH REPORT

Information on patent family members

National Application No

PCT/US 96/02912

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-2250156	27-05-92	NONE	
US-A-5229850	20-07-93	JP-A- 4086086	18-03-92
		CA-A,C 2048076	31-01-92